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A SURVEY OF

INDUSTRIAL HEALTH-HAZARDS
AND
OCCUPATIONAL DISEASES
IN OHIO

By E. R. HAYHURST, A. M., M. D.
DIRECTOR, DIVISION OF OCCUPATIONAL DISEASES.
STATE BOARD OF HEALTH

PREPARED IN CONFORMITY WITH
HOUSE JOINT RESOLUTION No. 12 – EIGHTIETH
GENERAL ASSEMBLY OF OHIO

UNDER THE GENERAL SUPERVISION AND
DIRECTION OF THE

OHIO STATE BOARD OF HEALTH

E. F. McCAMPBELL, Ph. D., M. D.
Secretary and Executive Officer

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INDUSTRIAL HEALTH-HAZARDS AND OCCUPATIONAL DISEASES IN OHIO

LETTER OF TRANSMITTAL.

COLUMBUS, OHIO, February 1, 1915.

To the Members of the Eighty-first General Assembly, Columbus, Ohio.

GENTLEMEN:—Pursuant to House Joint Resolution No. 12, (Laws of Ohio, 1913, Vol. 103, p. 975). On behalf of the State Board of Health I am herewith transmitting to the Eighty-first General Assembly the results of the survey which was directed and authorized. This survey deals with the effect of various occupations upon the health of those workers engaged therein. The resolution authorizing and directing this investigation is herewith appended.

Respectfully,

E. F. MCCAMPBELL, Ph. D., M. D.,
Secretary and Executive Officer,
Ohio State Board of Health.

JOINT RESOLUTION

Authorizing and directing the state board of health to make an investigation of occupational diseases.

WHEREAS, The employment of men and women in certain occupations is known to be attended with more than ordinary danger to health, giving rise to what is known as "occupational diseases", and

WHEREAS, Unnecessary sickness and shortening of life, from whatever cause, is a serious loss and of grave concern to the state and to all the people, and

WHEREAS, It is believed to be possible, by public education and by the enforcement of proper measures, to largely prevent unnecessary sickness and premature death among employes in various trades and occupation, therefore,

Be is resolved by the General Assembly of the State of Ohio, That the state board of health is hereby authorized and directed to make a thorough investigation of the effect of occupations upon the health of those engaged therein with special reference to dust and dangerous chemicals and gases, to insufficient ventilation and lighting, and to such other unhygienic conditions as in the opinion of said board may be specially injurious to health, and to report to the next general assembly the results of such investigation, with such recommendations for legislative or other remedial measures as it may deem proper and advisable.

Be it further resolved, That the finance committee of the House and the Senate be requested to place in the general appropriation bill an appropriation of $7,000 for the year 1913 and $7,000 for the year 1914 for carrying on the above work by the state board of health.

[Signed] C. L. SWAIN,
Speaker of the House of Representatives.

[Signed] HUGH L. NICHOLS,
President of the Senate.

Adopted February 13th, 1913.

OHIO STATE BOARD OF HEALTH,

DIVISION OF OCCUPATIONAL DISEASES,

COLUMBUS, January 31, 1915.

SIR: I beg to transmit herewith the Report of the Survey of Industrial Health-hazards and Occupational Diseases, embodying the results of the investigation made in compliance with House Joint Resolution No. 12, of February 13, 1913.

The Report deals with the investigation of the effect of occupations upon the health of those engaged therein, with special reference to health-hazardous conditions as opinionated by a special staff of investigators who have inspected the work places of about half of those employed in manufacturing industries and in some non-manufacturing industries in the State of Ohio.

I am, very respectfully,

EMERY R. HAYHURST,
Director, Division of Occupational Diseases,
Chief, Survey of Occupational Diseases.

DR. E. F. MCCAMPBELL,
Secretary and Executive Officer,
Ohio State Board of Health.

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Acknowledgement is made to the following establishments, societies and persons for photographs and cuts kindly submitted or loaned for the purpose of illustrating the Report — all in Ohio unless otherwise specified:

American Encaustic Tiling Company Zanesville.
Captain J. R. Harris, M. D., (Fort Slocum, N. Y.).
Dean Edward Orton, Columbus.
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The U. S. Bureau of Mines (Washington, D. C.).

LIST OF ILLUSTRATIONS.

INTRODUCTION.

Among the factors which are causing disaster in the onward march of civilization, there has been brought to light, in the last half century, afflictions called occupational diseases, which appear to be due to attempted or forced adaptations to unnatural environment. The present investigation of the State Board of Health has been popularly termed "The Occupational Disease Survey", but it was the intention of the legislature, which authorized the investigation, to go much deeper than this, as should have been the case, and endeavor to determine the underlying causes which contribute to the "unnecessary sickness and shortening of life," which "is a serious loss and of grave concern to the state and to all the people." Consequently this report will be found to deal very largely with industrial hygiene (of the workplace,—not of the worker's home and other outside factors), and the extent to which health-hazards have been found to exist in the principal industrial processes in the state. The prevalence of occupational complaints and diseases has not been overlooked, however, as may be seen from a scrutiny of the context. Inasmuch as the principal efforts and most of the time available were directed towards subject of hygiene, it is well to say that the lists and citations of occupational diseases represent but a small part of those which actually exist, and these lists could have been greatly extended had the principal investigation been developed in that direction.

The plan of the present report has been, *first*, to analyze the available vital statistics (Part II.) to define the principles of industrial hygiene which have served as guides to the survey itself (Part III.), to designate the chief industries and processes of concern and to show their relative importance in numbers employed (Part IV.); *secondly*, to determine the hygienic status of health-hazardous trades in the state through an investigation of them by a corps of physicians and hygienists (Part V.), to sum up and classify the authentic cases of occupational diseases which have been reported to the Division (Part VI.); and, *thirdly*, to give the results of some special investigations of elemental importance and remedial character which have been undertaken (Part VII.), and to draw certain general conclusions (Part VIII.).

In Part V., especially, it has been the endeavor to show the short-

comings in industries, in trade processes, and in workers themselves, which have contributed to the figures given in Parts II. and VI.

It must be pointed out that this is but a survey, and as such is necessarily of a mantle character and has not aimed to go deeply into any particular part of the field. It has not touched upon industrial accidents nor their prevention. It has been devoted, principally, to the manufacturing pursuits, by no means all of which have been covered, but the principal ones, from a health point of view, have, it is believed, been included. The casual reader, however, can see in the report itself plenty of opportunity for more investigations and more intensive researches.

The report is not a description of industries and processes, as sometimes such reports are, but is meant to be an application of about a dozen well defined health-hazards to workplaces and work processes, with subsequent gradings as "good," "fair," or "bad." Only enough description is given to define the various trade processes when looked upon from a health-conservation aspect. The findings of each process are taken up in the same manner, so that the arrangement is an index of itself which can be easily followed. The use of capital letters has been adopted to specify definite industries or definite trade processes which are described in the report, and wherever such capitals are used the reader's attention is directed to the index for the corresponding subject matter. Arabic numerals have been used as much as possible to facilitate reading and to save space.

The relationship between poisons used in industry and the symptoms of poisoning which develop from contact with such poisons is easy to comprehend, and there is no hesitancy in calling such affections "occupational diseases". In the same way, certain infectious, deformities, calluses, and so on, can be determined as specifically occupational. But the relationship between the health-hazards of industry and general diseases is more or less indefinite. I have attempted to opinionate some of these relations as closely as possible, and as fully as consistent with the findings on industrial hygiene and our present day knowledge of morbid conditions and the causes of these conditions. It is obvious that there is, and always will be room for differences of opinion along these lines. However, I know of no better method than that which has been adopted here to correlate the indisputable existence of preventable diseases and deaths among occupied persons on the one hand—both diseases and deaths having great variations according to occupations—with the evidence which industrial malhygiene shows on the other hand.

The truth of the matter is that occupational diseases are ex-

ceedingly common. They are, however, *primary diseases* and only little attention is paid to their symptoms when they are calling loudest for recognition and at a time when they are easy to cure and control. On the other hand deaths directly due to them are among the rarest of happenings, this because *degenerative diseases,* which are secondary (of the heart, kidneys, lungs, etc.) prove to be the terminal afflictions. Thus, frequency of urination, in the case of the painter, characterizes turpentine poisoning, but nephritis is the ultimate cause of death.

Such investigation as this would be greatly improved, were there extant accepted standards for all conditions. Such standards would enable an investigation not only to determine exactly, then, the amount of dust, illumination, humidity, devitalizing air, temperature, etc., actually present, but the terms used in opinionating—"good", "fair", "bad"—could have a defined significance. Until these standards are set and agreed upon, it is necessary to do as has been done here—rely upon the opinions of qualified but disinterested persons. The next logical step in the field of industrial hygiene and occupational diseases is the establishing of these standards, and their adoption by a proper body having recognized authority.

The immediate survey and field work has been conducted according to definite plans by the persons named below, exclusive of the Director. Attention was given to securing men who had some familiarity with industrial processes as well as academic, medical and hospital training and associations. The principal investigators were recommended by health officials in Ohio cities and were appointed on the authority of the executive officer of the State Board of Health:

Raymond A. Ramsey, A. B., M. D........................Columbus
Ernest H. Cox, B. S., M. D..............................Cleveland
Arthur E. Osmond, M. D.................................Cincinnati
Roscoe P. Albaugh, M. D...............Columbus and Winchester
Harry L. Rockwood, M. D.............Cleveland and Warrensville
Halbert B. Blakey, M. D.................................Columbus
Assist. Prof. W. A. Starin, M. A......................Columbus
John D. Schonwald, M. D...............................Cincinnati
Chas. P. Blair, A. M., M. D.............Peebles and Chicago (Ill.).

In addition the following gentlemen devoted time as specified:

Prof. Wm. L. Evans, Ph. D., directed chemical researches and participated in field investigations.

Chas. R. Parkinson, M. A., conducted special chemical researches.

Cullen W. Irish (senior medical and university student), and Elmer A. George, A. B., M. D., assisted in clerical work and participated in field investigations.

Prof. Ernest Scott, B. S., M. D., cooperated in the investigation of the fatal silo accidents at Athens, Ohio.

In conclusion, I desire to acknowledge my indebtedness to Dr. Ludvig Hektoen, Director, Memorial Institute for Infectious Diseases and Professor of Pathology in Rush Medical College, Chicago, for valuable suggestions and advice in the conduct of the survey.

Columbus, Ohio, Jan. 1, 1915. E. R. H.

A SURVEY OF INDUSTRIAL HEALTH-HAZARDS AND OCCUPATIONAL DISEASES IN OHIO.

PART I.

HISTORICAL NOTES.

In the First Annual Report of the Ohio State Board of Health, 1886, page 10, we read that the President appointed a standing committee upon Hygiene of Occupations and Railway Sanitation, with Dr. John D. Jones, Cincinnati, as chairman. The Second Annual Report (1887) contains a five-page article by Dr. Jones upon "The Effect of Occupation Upon the Health of Individuals", in which occurs an account of the danger to lead-workers, white lead-workers. barrel-fillers, file-cutters, saw-makers and tool-makers, wool and cotton workers, employes in gas works, as well as a discussion of fresh air and light, the employment of women, and a table adopted from Dr. Wm. Ogle, of London, England, showing the mean annual death rate of males in various occupations.

The next year (1888) a most masterly article in this field, entitled, "The Luminous Beam", was written by Josiah Hartzell, Ph. D., Canton, Ohio, who is at present a member of the State Board of Health.* This paper was read before a Sanitary Convention held under the auspices of the State Board of Health at Akron, Ohio, January 25th and 26th, 1888, and is contained in the Second Annual Report of the State Board of Health, 1887. The opening statement in this paper is as follows:

"All intelligent workers in behalf of good health clamor for ventilation.

"Why?

"To the end that the air to be breathed into the lungs may be abundant in supply and pure in quality."

"Everyone is familiar with the appearance of a sunbeam piercing the darkness of a darkened room." With this sunbeam as the theme, the author next discusses, in a most able and interesting manner, the dust particles, smoke particles, germ growths, and various

*Dr. Hartzell died at his home in Canton, Ohio, on November 11, 1914, at the age of 83 years.

effusive matters, which can be seen to pollute this luminous beam. The author takes up the subjects of "sawgrinder's consumption", "potter's asthma", "brassfounder's ague", lead colic, matchworker's disease, etc., and states that in all these employments it may be shown that both the sick and death rate have been materially lessened by promoting ventilation; notably, by the application of certain devices for the protection of workmen from the inhalation of dust and harmful fumes.

Since the dates referred to above, laymen as well as medical men have repeatedly called the attention of the public to the subject of industrial hygiene and occupational diseases. Finally, in 1913, or twenty-nine years after the first citation above given, the Legislature of the State of Ohio passed two bills as follows: (1) House Joint Resolution No. 12, (see below) "Authorizing and directing the State Board of Health to make an investigation of occupational diseases", also authorizing the Board to make a thorough investigation of industrial hygiene; and (2) an act "To require the reporting of certain occupational diseases" to the State Board of Health, by every physician in the state, attending or called upon to visit a patient whom he believed to be suffering from occupational poisonings, or or any other ailment or disease contracted as a result of the nature of the patient's employment. In addition to the above two, which have laid the foundation for this report, there was passed an act "For the prevention of occupational diseases with special reference to lead poisoning." But as this act particularized the manufacture of certain lead compounds, it has eventuated in applying to but two or three establishments in the state, and to the protection of some less than 300 employes.

During the course of this survey, early in 1914, two very important judicial decisions have been rendered, one by Judge Robert C. Pugh, of the Superior Court of Hamilton County, declaring "lead poisoning" to be a "personal injury", and allowing the complainant an indemnity against his employer of $500. The second decision was of much greater importance, and was made by Judge O. J. Cosgrave, of the Common Pleas Court, Hamilton County, overruling the position taken by the Industrial Commission of Ohio and declaring that an occupational disease is a personal injury and therefore should come under the new insurance law for compensating persons meeting personal injury while in the course of their employment.

The funds for the establishment of the Survey of Occupational Diseases became available May 1st, 1913. The investigations began May 15th, 1913, the first month being spent in statistical researches.

the printing of forms, etc. The factory and workshop investigations began June 9th, 1913, and have continued without interruption up to the time of publishing this report. By the first of September, 1913, printed matter, calling the attention of physicians throughout the state to the occupational disease reporting law, and blanks for reporting the same were mailed to 7,500 physicians within the state. Realizing that publicity was, and is, a principal feature in a public health matter of this sort, the Division of Occupational Diseases has compiled and issued some twelve pamphlets upon this subject, each article being first printed in the MONTHLY BULLETIN of the State Board of Health. A part of the Public Health Exhibit of the State Board of Health has been given to the subject of industrial hygiene and occupational diseases. In connection with the Exhibit a short lecture, accompanied by stereopticon slides, and moving pictures, has been given several times a month in various cities of the state.

* * * * *

House Joint Resolution No. 12 and House Bill No. 187, copies of which follow, are the two enabling acts which authorized the investigation of occupational diseases by, and the reporting of the same to the State Board of Health. A copy of the blank certificate used for reporting and the instructions accompanying the certificate follow:

(House Joint Resolution No. 12.)

Laws of Ohio, 1913, Vol. 103, p. 975.

JOINT RESOLUTION

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mendations for legislative or other remedial measures as it may deem proper and advisable.

Be it further resolved, That the finance committee of the House and the Senate be requested to place in the general appropriation bill an appropriation of $7,000 for the year 1913 and $7,000 for the year 1914 for carrying on the above work by the state board of health.

C. L. SWAIN,
Speaker of the House of Representatives.
HUGH L. NICHOLS,
President of the Senate.

Adopted February 13th, 1913.

1913.
Jan. 23 — First introduced by Mr. Acker.
Jan. 23 — Laid over under the Rules.
Jan. 27 — Referred to Committee on Labor.
Jan. 29 — Referred back from Committee on Labor.
Jan. 31 — Recommitted to Committee on Finance.
Feb. 6 — Reported by Committee on Finance.
Feb. 10 — Adopted by House.
Feb. 12 — Passed by the Senate. Amended.
Feb. 13 — Concurred in by House of Representatives.
Feb. 25 — Enrolled and signed.
Feb. 28 — Filed in office of Secretary of State.

Laws of Ohio, 1913, Vol. 103, p. 184, (Sections 1243-1 to 4, G. C.)

(House Bill No. 187.)

AN ACT

To require the reporting of certain occupational diseases.

Be it enacted by the General Assembly of the State of Ohio:

SECTION 1. Every physician in this state attending on or called in to visit a patient whom he believes to be suffering from poisoning from lead, phosphorus, arsenic, brass, wood-alcohol, mercury or their compounds, or from anthrax, or from compressed air illness, or any other ailment or disease, contracted as a result of the nature of the patient's employment, shall within forty-eight hours from the time of first attending such patient send to the state board of health a report stating:

(a) Name, address and occupation of patient.

(b) Name, address and business of employer.

(c) Nature of disease.

(d) Such other information as may be reasonably required by the state board of health.

The reports herein required shall be made on, or in conformity with, the standard schedule blanks hereinafter provided for. The mailing of the report, within the time required, in a stamped envelope addrssed to the office of the state board of health, shall be a compliance with this section.

SECTION 2. The state board of health shall prepare and furnish, free of cost, to the physicians included in the preceding section, standard schedule

blanks for the reports required under this act. The form and contents of such blanks shall be determined by the state board of health.

SECTION 3. Reports made under this act shall not be evidence of the facts therein stated in any action arising out of the disease therein reported.

SECTION 4. It shall furthermore be the duty of the state board of health to transmit a copy of all such reports of occupational diseases to the proper official having charge of factory inspection.

C. L. SWAIN,
Speaker of the House of Representatives.

HUGH L. NICHOLS,
President of the Senate.

Passed March 25, 1913.

Approved April 23, 1913.

JAMES M. COX, *Governor.*

Filed in office of the Secretary of State April 24, 1913.

WRITE PLAINLY WITH INK — THIS IS A PERMANENT RECORD.

N.B. — Every item of information should be carefully supplied. The exact statement of OCCUPATION is very important. Physician should state DIAGNOSIS in plain terms. See instructions on back of certificate.

OHIO STATE BOARD OF HEALTH

CERTIFICATE OF INDUSTRIAL DISEASE.

NAME OF PATIENT ——————————

ADDRESS: Street and No. ——————— City or Village ———————

PERSONAL AND STATISTICAL PARTICULARS.

Sex	Age	Color	Country of Birth

Single, married, widowed or divorced (write the word)

Occupation

(a) *Present* trade, profession or work ———————

Particular kind of work in such trade. etc ———————

Date of entering present occupation ———————
Employers' name ———————
Address ———————
Business (kind of goods made or work done) ———————

(b) *Previous* occupations:

Name of occupation	Entered (year)	Left (year)

Previous illness, if any, due to occupation:

Disease or illness	Year

MEDICAL CERTIFICATE OF DISEASE

Diagnosis of present illness ———————

Chief symptoms and conditions ———————

Date first symptoms appeared ———————

Complicating Diseases (such as alcoholism, syphilis, tuberculosis, etc.) ———————

Additional facts ———————

Date of diagnosis ———————, 191—

(Signed) ———————, M. D.

———————, 191— (Address) ———————

Mail to STATE BOARD OF HEALTH, Page Hall, University Campus.

(ON BACK OF THIS CERTIFICATE IS PRINTED THE MATTER BELOW).

OHIO STATE BOARD OF HEALTH,

COLUMBUS.

AN ACT — To require the Reporting of Certain Occupational Diseases — (Passed March 25, 1913.)

SECTION 1. Every physician in this state attending on or called in to visit a patient whom he believes to be suffering from poisoning from lead, phosphorus, arsenic, brass, wood-alcohol, mercury or their compounds, or from anthrax, or from compressed-air illness, or any other ailment or disease, contracted as a result of the nature of the patient's employment shall within forty-eight hours from the time of first attending such patient send to the State Board of Health a report stating:

(a) Name, address and occupation of patient. (b) Name, address and business of employer. (c) Nature of disease. (d) Such other information as may be reasonably required by the State Board of Health.

The reports herein required shall be made on, or in conformity with, the standard schedule blanks hereinafter provided for. The mailing of the report, within the time required, in a stamped envelope addressed to the office of the State Board of Health, shall be a compliance with this section.

SECTION 3. Reports made under this act shall not be evidence of the facts therein stated in any action arising out of the disease therein reported.

AN ACT — For the Prevention of Occupational Diseases with Special Reference to Lead Poisoning.

SECTION 7. Every physician * * * finding what he believes to be symptoms of lead poisoning shall * * * within forty-eight hours after such examination and finding * * * send a report thereof in duplicate, one copy to the State Department of Factory Inspection and one to the State Board of Health * * * The examining physician shall also, within the said forty-eight hours, report such examination and finding to the employer. (Passed April 18, 1913.)

These forms are furnished by the State Board of Health and should be used for all reports. In filling out, note carefully the instructions below.

INSTRUCTIONS FOR FILLING OUT CERTIFICATE.

In General. The *medical certificate* on the right hand side the physician alone can furnish. The *personal and statistical particulars* on the left hand side must be secured by the physician either from the patient, or, in fatal cases, from the family precisely as for similar information in certificates of death sent to boards of health.

Present Occupation. Precise statement of occupation is very important so that the relative healthfulness of various pursuits may be known. It is necessary to know both general trade or profession (for example, *printer* or *brass worker*) and also the particular kind of work or branch of the trade (as *hand compositor* or *linotype operator* for a printer, or *polisher* or *buffer* for a brass worker.)

Date of entering present occupation is important to determine how long the worker may have been exposed to the hazard before contracting the disease.

Employer's name, address and business are necessary to ascertain dis-

tribution of occupational diseases by industries, many trades (e. g., machinists) being common to different industries.

Previous occupations need to be known, if possible, because present illness may be due to a former rather than present occupation, and industrial disease is frequently a cause of change of occupation. Give simply the name of each distinct occupation which the patient may have followed, with the year he entered and the year he left,

Previous Illnesses. This refers either to previous attacks of present disease, or to any other disease, *due to occupation.* All that is required is the name of each such disease or illness with the year in which it occurred. Such information, when it can be secured, will show whether the case reported is the first attack or not, and when combined with statement of previous occupations, will afford an outline history of the patient as to occupational disease.

Medical Certificate. Only the last two items specified for this require any explanation. In making these reports it is necessary to consider the possible influence of factors other than occupation as causes of the disease. For this reason any *complicating diseases* should be noted, such, for example, as alsoholism or syphilis in connection with the arteriosclerosis in cases of lead or other metal poisoning. The possible effect of other factors, such as poor hygienic conditions in the home, or other personal conditions, must be considered, and when discoverable should be noted under *additional facts.*

E. F. McCampbell, M. D., *Secretary.*

PART II.

THE GENERAL PRINCIPLES OF INDUSTRIAL HYGIENE.

INDUSTRIAL VITAL STATISTICS.

In order to avoid needless repetitions in the description of Industries and Processes investigated in the State during the course of the Survey, there will be discussed at this place and in Part III, those factors which are looked upon as the principles, or essential features, of industrial hygiene, avoiding, as far as possible, all niceties and refinements, and endeavoring to adhere strictly to the features which are primarily detrimental to health.

For those who wish to go into this subject more fully, we recommend the following authoritative works and references:

"Diseases of Occupation and Vocational Hygiene", edited by George M. Kober, M. D., Professor of Hygiene, Georgetown University, President, Section on Hygiene of Occupations, 15th International Congress on Hygiene and Demography, and Wm. C. Hanson, M. D., Massachusetts State Board of Health, Instructor in Harvard University and Massachusetts Institute of Technology, with the assistance of various contributors, American and Foreign, P. Blakiston's Son & Co., Philadelphia, 1915 (in print).

"The Modern Factory", George M. Price, M. D., formerly Director of Investigation, N. Y. State Factory Commission, John Wiley & Sons, 1914, 574 pp., $4.00.

"Occupational Diseases", W. Gilman Thompson, M. D., Professor of Medicine, Cornell University Medical College, New York City, D. Appleton & Co., 1914, 734 pp., price $6.00.

"Diseases of Occupation", by Sir Thomas Oliver, E. P. Dutton & Co., New York, 1908, 427 pp., price $3.00.

"Industrial Poisoning", Dr. J. Rambousek, translated from the German by Dr. Thomas M. Legge, Edward Arnold, London, England, 1913, price $3.50.

"List of Industrial Poisons", by Summerfeld and Fischer. Reprinted from U. S. Labor Bulletin No. 100, by the Ohio State Board of Health, with an Industrial Index. Discusses 54 common industrial poisons, branches of industry in which poisoning occurs, mode of entrance into the body, symptoms of poisoning, and measures for the protection of workers. A few copies of this are still obtainable from the Ohio State Board of Health. Enclose a two-cent stamp.

"Fatigue and Efficiency", by Josephine Goldmark, 890 pages, Russell Sage Foundation, 1912, price $3.50.

"Symposium on Ventilation", as reported in Journal of Industrial and Engineering Chemistry, March, 1914.

"Mortality from Consumption in Dusty Trades", by Frederick L. Hoffman. U. S. Labor Bulletin, No. 79, Nov., 1908.

Mortality from Consumption in Certain Occupations", by Frederick L. Hoffman. U. S. Labor Bulletin, No. 82, May, 1909.

Consult also any standard text-book upon Physiology (Howell, Stewart, Hall) and upon Hygiene (Harrington, Bergey) for effects of light, heat, fatigue and other hazards, vital statistics, etc.

The first fact to take cognizance of in the inspection of a work-place is the presence or absence of health-hazards.

An industrial *health-hazard* may be *defined* as any condition or manner of working that is unnatural to the physiology of the human being so engaged. This physiology is adaptable to quite wide variations in environment, but the rule holds absolute that the subjection to conditions which are unnatural to the physiology and habit of man results in pathology or disease.

Where a factory inspector looks for hazards to life, limbs and health, and is guided by the standards of protection which are present and which must not fall below a minimum required by law, the medical hygienist looks for hazards to health and longevity, and his standards are the presence or absence of well recognized hazards to health and the amount of occupational health complaints and diseases to be found. These latter he gets by interviewing and examining workmen themselves, their physicians, community health officials, vital statistics, etc. In a word, his business is to connect health-hazards with diseases and deaths. He is, then, both a hygienist and a diagnostician.

There is nothing strange or new, as a rule, about these hazards, but a proper conception of them and their effects is a necessary preliminary to the reports which follow.

Industrial health-hazards as they concern the industries of Ohic are listed, in an arrangement easy to remember, thus:

DUST,	DEVITALIZED AIR,	INACTIVITY,
DIRT,	TEMPERATURE,	INFECTIONS,
DAMPNESS,	FATIGUE,	POISONS.
DARKNESS,		

As an aftermath to the above, it is necessary to mention *industrial stimulantism* which is usually alcoholism, coffeeism, or drug ism. Stimulantism is promoted by subjection to one or more of the above health-hazards; or, because of the absence of good drinking water; or, because of a tradition among workers in certain lines that alcoholic liquors tend to stimulate them and to protect them from the effects of poisons, dusts, gases, or hard work to which they may be submitted; or to the fact that the employers promote alcoholism among their workmen by permitting the drinking of intoxicating liquors while at work; and, finally, to the fact that there is an

absence of a welfare attitude, or an industrial efficiency department in connection with an establishment. — Coffeeism, in females, may represent alcoholism in males.

The second most important feature in the relationship between work and disease is the problem of the worker himself. Some workers are very much more susceptible to the health-hazards mentioned above than are others, so much so that as hygienic as certain industries and processes can possibly be made, still there are certain classes of persons who should not engage in them. This is exemplified today, in many instances, as a matter of natural selection; for instance, the more delicate and sickly disposed persons do not follow the more fatiguing or heat-exposing trades. Unfortunately this does not apply so closely to older workers who have been following the more hazardous undertakings for years, and who, having become weakened from various causes, still endeavor to remain at their chosen avocations, irrespective of the damaging effects upon the body. Much of this question of the human factor will be solved in the future by a selection of employes through physical examinations for occupations to which they are best fitted. As an economical principle this must be done for the benefit of employer, employe and society. Having picked the proper physically or mentally capable person for the position at hand, it is further necessary to eradicate health-hazards, as far as possible, if we expect to put a check upon unnecessary disease and a check upon the shortened span of life which exists among occupied persons today.

A third feature requiring discussion is that of being able to "get used to" the various health-hazards. This, many times, is a defence put up by employers, and even by employes for taking various health risks. It has some substance when superficially considered. For instance, the newly apprenticed barber soon gets used to the discomfort, pain and stiffness which first appears in the hand and arm using the scissors; the baseball player soon gets used to the muscular effort required in throwing the ball in the Spring practices, and is no longer inconvenienced by soreness, stiffness, etc. In this connection it may be said that fatigue is the factor concerned, and it is well known that what proves to be fatiguing to a person today may be performed at perfect east after a few days of experience. This is because a physiological regulation has taken place in which more blood, a better circulation and nerve control are established in the parts used and fatigue anti-toxin is developed to protect the body from fatigue toxin. Since this is a physiological adaptation, it must be considered perfectly normal. In other words, what was primarily

fatigue, therefore a health-hazard, has, by a natural adaptation, become no longer fatigue. It is a phenomenon within the boundaries of physiology.

The vital point is: How far can such physiological adaptations take place without ultimate damage to the organism? We may state it as fundamental, that outside of the adaptation cited for fatigue, no other health-hazard can be "gotten used to". We mean accustomed to, in a physiologic, and therefore a normal manner. No person can become habituated to an existence in a damp, dark, or foul-aired place. Nor again to the inhalation of dust, to the constant exposure to high temperatures, nor to sudden changes in temperatures. The physiologic mechanisms of the human body are not capable of adapting themselves to the conservation of health and vitality in the continued presence of such hazards.

The subjection to poisons is absolutely incompatible with health and a normal span of life. It is commonly thought, for instance, that a person can soon become habituated to the inhalation of benzine fumes, so that the intoxicating effects, producing giddiness, dizziness, a feeling of elation and loquaciousness, experienced during the first week or so of exposure, but which, as a rule, pass off thereafter, have been "gotten used to". This is an erroneous idea. Apply the same argument to alcohol. Simply because it may take more to get the chronic toper intoxicated is no proof that he has become habituated because of a physiological re-enforcement. He has simply become tolerant. There is a vast difference between toleration and the physiologic normal. Toleration lasts only so long as the extra powers, with which all vital organs are endowed, can meet and compensate for the oppression. For instance, it has been shown that as little as 1/24th part of the normal amount of kidney substance will maintain life in the individual, and, in a similar way, other organs and parts of the body are superiorly equipped. But the utilization of physiological functions to their limits of toleration is abnormal and unnatural, and a transgression of natural laws is bound to result in disaster. This is just as true of physiology as it is of physics. Hence toleration of unnatural environmental conditions which many persons look upon as "getting used to" situations is untenable, and will finally result in disease, perhaps in invalidism, and most certainly in untimely death.

This misconception of the ability of the human being to become accustomed to health-hazards, such as the ten fundamental ones above cited, is responsible for a very large percentage of the preventable sickness and mortality shown in statistics herewith:

(1) In Ohio, in the year 1913, there were 68,378 deaths. Over half of these would not bear scrutiny as either timely or justifiable. Most of the questionable deaths occurred in adult life and before 70 years of age:

QUESTIONABLE DEATHS.

Lock Jaw	67	TOTAL CIRCULATORY DISEASES	11,358
Tuberculosis (Total)	6,555	Lung Diseases (other than Tuberculosis)	6,850
Cancer (Total)	4,049	Bright's Disease (Total)	3,958
Rheumatism	226	Skin Diseases	212
Anemia	240	External Causes (violence, etc.)	6,266
Alcoholism	315		
Nervous Diseases	6,882		
ORGANIC HEART DISEASE	8,907		

As against these there were but 822 deaths charged to OLD AGE, as such.

(2) *Diseases of the Circulation* and particularly *Organic Heart Disease* are causes of death pre-eminent in adult life. The following table shows, for the State of Ohio, the increase in death rates per 100,000 population from these causes:

DEATH RATES.

Year.	*All causes combined* (*per* 1,000)	*Circulatory Diseases.*	*Organic Heart Disease.*
1909	12.76	155.95	108.26
1910	13.76	185.03	126.63
1911	13.09	206.95	157.32
1912	13.34	227.80	177.80

(3) Deaths occurring under 70 years of age from Circulatory or Heart Diseases should be considered preventable in the vast majority of instances. In Ohio, in 1912, over $\frac{1}{6}$ of all deaths were due to Circulatory Diseases and $\frac{1}{8}$ of all deaths were due to Organic Heart Disease alone. As a cause of death Tuberculosis has been almost doubly outstripped by these chronic degenerative diseases, 58% of which have occurred before 70 years of age, and 20% of which have occurred before 50 years of age. If the classification could enable us to separate out the "farmers", these rates for the balance of the people of the state would be very much higher.

A "Study of the Handicapped", made by the Council of Social Agencies and The Hospital Social Service in Cincinnati, states, "Cardiacs (i. e. persons suffering from heart disease) constitute at once

the largest single class and the one that presents the greatest difficulties. Few of them, because, among other reasons, their handicap is not evident, at present obtain suitable employment. They are, therefore, constantly relapsing into incapacity for work and need hospital treatment."

(4) An analysis of the General Mortality Statistics for the registration area of the United States shows the following for the census year 1909:

MORTALITY AMONG OCCUPIED MALES.

	Those in Agricultural Pursuits.	*Those in 131 Trades and Callings.*
Deaths from *preventable* causes (6/7 are diseases)...	27.4% of all deaths.....	43.0% of all deaths.
Deaths from *degenerative* diseases (under 70 years of age)	26.5% of all deaths.....	31.0% of all deaths.
Total deaths after 70 years of age	35.9% of all deaths.....	13.4% of all deaths.

In the above "Occupied Males" includes professional persons, officials, proprietors, those in domestic and personal services, as well as those we term real workers, viz., in trade and transportation, manufacturing and mechanical pursuits, mines, quarries, etc.

(5) The relationship between different callings and a given disease, such as *tuberculosis*, can be fairly satisfactorily determined. The following table furnishes an example. Compare the first column with the second column, and note that housing, habits, dietetics, etc., cut no figure, at least with the first four comparisons:

TUBERCULOSIS DEATH RATE.

Quarrymen and miners......	9. %	Stonecutters (indoor work).	29. %
Carpenters	10. %	Painters	19. %
Iron and steel workers.......	16. %	Brassworkers	31. %
Domestics	19. %	Stenographers	39. %
Farmers, planters and overseers	6.6%	95 out of 100 callings 8.0 to	43. %

In this connection the State Board of Health has issued a pamphlet entitled, "Consumption and Preventable Deaths in American Occupations", which shows many other ratings for trades and callings.

(6) *Pulmonary Tuberculosis* is a cause of death which concerns adults much more than children. Reliable statistics in Ohio

are only available since 1909. It must be remembered that many Ohio persons suffering with tuberculosis go to western states where many of them die. Because of this morbidity migration in the case of this disease, the mortality rates of states such as Ohio are not as high as they should be. Reports in Ohio show that there are seven cases of tuberculosis to every death. Hence, there are over 35,000 living cases in the state at present. The rates for the last five years in Ohio are, per 100,000 estimated population, as follows:

Year.	*No. Deaths.*	*No. Deaths.*
1909	5,805	121.91
1910	6,176	129.70
1911	5,992	123.76
1912	5,679	115.80
1913	5,479	110.35

The table shows that the disease as a cause of death is gradually decreasing. But the table below shows to what extent young people bear the brunt of the plague:

DEATHS FROM PULMONARY TUBERCULOSIS, STATE OF OHIO, 1909-1912.

Years of Age.	*No. of Deaths.*
15-19	1,698
20-24	3,156
25-29	3,228
30-34	2,810
35-39	2,478
40-44	1,867
45-49	1,543
50-54	1,276
55-59	1,108
60 and over	3,187

(7) The following is abstracted from a paper entitled, "A Study of Causes of Tuberculosis", by Roy T. Nichols, Department of Hygiene, Western Reserve University. The study was made in Cleveland, and was devoted to the year 1912:

3,247 cases of tuberculosis were registered in Cleveland in 1912. Total number was probably 10% higher.

70% were estimated as charity cases.

"It is doubtful whether more than 15% could be attributed to an inherited tendency."

4 months represents the average stay of each patient in an institution (based upon 250 cases studied).

Cost for the care of each patient averaged $1.25 per day.

The report concludes as follows:

"Is it not time that we not only recognize as one must, that tuberculosis is not the inevitable lot of certain races, or the inherited lot of certain families, but that it is largely due to the effect of the industrial and living conditions, and that we must therefore expend large amounts not only in combating the disease by sanitary instruction and segregation, but by appropriations for the safeguarding of workers in certain industries and for the improving of housing conditions? If any conclusions can be drawn from this report, it is that all efforts to combat the rapid spread of tuberculosis must fail unless it reaches down to the economic basis of life. This report shows conclusively that men are succumbing to tuberculosis, not because they are destined to or because they are ignorant or because they are willing to take bigger chances than other people, but because they are the slaves of our industrial system that decrees this man who toils for 10 or more hours a day in dust-laden, overheated air, is the man with wages so small that he can buy for himself and his family only a few small close rooms for their place of habitation, rather than a place that has the recreative gifts of sunlight and fresh air. When we awaken to the fact that such industrial conditions and such living conditions must not exist, not only because they are not humane or decent, but because society cannot afford them, because they too rapidly manufacture these helpless derelicts that must be supported by charity until death relieves them and us, we will have gone far towards removing the cause of tuberculosis."

(8) The following Table, based upon U. S. Vital Statistics reports, compares the Proprietor and Professional Class (column A.) with the Working Class (column B.) in respect to the prevalence of *six preventable causes of death*. The rates represent the number of deaths from each cause out of every 100 deaths:

Cause of Death.	A. *Death Rate.*	B. *Death Rate.*
Tuberculosis	8.22	17.53
Accidents and injuries	5.20	11.85
Pneumonia	6.89	8.48
Suicide	2.13	2.76
Typhoid fever	1.88	2.35
Accidental poisoning	.43	.78
All preventable causes	24.75	43.75

In this connection the State Board of Health has a pamphlet which explains more fully these relationships.

The above tables, we believe, will show the serious economical questions which are involved.

PART III.

INDUSTRIAL HAZARDS.

We will next take up the individual health-hazard and discuss the elemental principles concerned.

DUST. — Dust may be inhaled, or ingested, or affect the skin, the eyes and the ear canals. The daily subjection to dust, for more than brief intervals at a time, is always damaging. The skin and

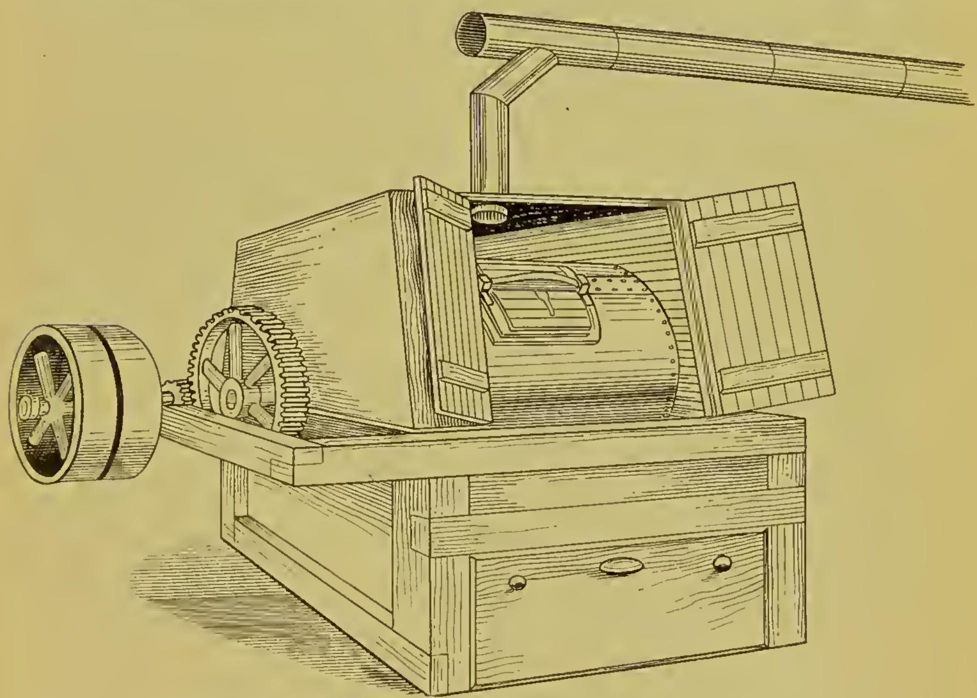

FIG. 1. DRY GRINDING AND MIXING OF INGREDIENTS.

Inclosed ball-mill in use in a porcelain enamel works, equipped with exhaust, dust-tight doors and collecting drawer. Adaptable in many plants.

the eyes may become physiologically inured to it, but not so with the internal organs. The least harmful dusts are those arising from the natural earth itself, such as the farmer is subjected to, although there are many exceptions to this in the case of alkali, sandy, or stony earths, etc. White flour and starch appear to be practically harmless to the normal person, soapstone dust and talc may be placed next in order, but a tuberculously-inclined person subject to these,

if they do no more than irritate the nose and throat and promote coughing, is almost certain to see an increment in his disease. Next in order of harmfulness come wood dust, bran dust, coal dust, clay dust, ore dust, mineral dust and stone dust. It will be seen that the organic dusts are the least harmful. Dusts in general produce a chronic catarrh of the respiratory and digestive organs. This leads to a fibrosis, which is the same process that is gradually brought about by old age. These catarrhs and fibroses result in lowered resistance of the damaged parts, and invite secondary diseases, which are usually the cause of death.

Fig. 2. Metal Polishing.

Ideal exhaust system for dust in a polishing department. Plenty of light.

All diseases of the lungs, due to dust, are called *pneumonoconiosis* (lung-dust-disease) ; iron dust, produces a condition called *siderosis;* sand, flint and stone, *chalcicosis* and *silicosis;* coal dust, *anthracosis:* cotton-fibre dust, *byssinosis;* clay dust, *aluminosis;* tobacco dust, *tabacosis;* etc. Fibrous tissue is formed around these particles in the lungs, destroying the function of respiration in such parts, and resulting, in the end, in a condition called *phthisis,* which is usually complicated by the presence of the *bacillus tuberculosis,* which is enabled to propagate because of the shutting off of the blood supply by the fibrous tissue. Two-thirds of a pint of coal dust has

FIG. 3. IRON AND STEEL WORKS INTERIOR.

Showing great care given to order, cleanliness and light. Quarters are also very spacious. The shape of this mill room renders it much easier to ventilate than if it were square.

been found in the lungs of a former coal miner. One-third of the weight of the lungs of a rock-driller has been found to consist of rock dust. Probably the most harmful dust of all, with the exception of poisonous dust, is emery dust, which is composed of exceedingly hard, crystalline, sharp particles; next to this comes sand or sandstone dust, to which workers are subjected in surfacing, polishing and crushing stone, in sandblasting, etc.

No person should work in a dusty atmosphere. Either by mechanical means, wet processes, and modification of processes, or by personal hygiene, as respirators, etc., dust can be kept out of the human system. Dry sweeping during work hours is a most vicious practice. Vacuum cleaning not only for floors, but in many dusty processes, is especially recommended. In dust mixing processes much of the material can be handled by vacuum pipes instead of scoop shovels.

Civilized man enjoys no immunity over the original or native man in this respect, for whom dust was not intended.

DIRT. — Dirt is put in as a health-hazard, not because to the cultured it is undesirable, but because dirt and disease co-exist. Dirt accumulating from trade processes becomes dust. A dirty place is the first place in which one is inclined to spit, hence dirt accumula-

FIG. 4. CLAY STOCK HOUSE.

An electric motor car, upon which is fitted a weighing apparatus, gathers the clays from the various bins.

tions are very liable to harbor disease germs. Dirt often contains poisons accumulating from manufacturing processes, which dry out and become dust. Vacuum cleaning is again called attention to.

We wish to give "Dirt", however, a broader scope. Disorderly accumulations of materials, by-products and waste products should be removed from workplaces because they have a sub-conscious deteriorating effect upon morals, upon the inclination and the ability to work, and upon the observance of health standards beyond the workplace, to say nothing of the hindrance to production itself. The insistence upon a clean and orderly place in which to work is fundamental from three points of view — physiologic, psychologic and productive capacity, or output.

DARKNESS. — Continual subjection to this health-hazard is universally acknowledged by practically all persons, as well as hygienists, as incompatible with health. The best light in which to work

Fig. 5.

Pupil of eye dilated to let in plenty of light when illumination is dim. Same pupil contracted to shut out excessive light.

Both Conditions Mean Eyestrain and Are Very Fatiguing.

is, of course, daylight — the only modification of this being protection from the direct rays of the sun, particularly for sedentary or confined workers. After this a good quality of artificial light does not appear to be detrimental to health. Illuminating engineers claim, and certainly, from a physiologic point of view, with very good reason, that more than half of workplaces are improperly lighted; also too expensively lighted, considering candle-power. In other words, there is a vast amount of importance to be given to lampshades, reflectors, globes, etc., as well as to positions. A flickering light, or a

dim light can be just as fatiguing, from its effects upon the human eyes, as the most laborious work. On the other hand, brilliancy is equally as dangerous. We see the extremes of this in some of the furnace and melting processes, where eyes are subjected to intense heat, as well as light, thus predisposing to ageing (cataracts, retinitis, conjunctivitis, etc.) Extremes are seen in the case of welding by the various types of blowpipes and electric methods now in vogue, in which not only the eyes require to be protected by alternate layers of

Fig. 6. Poor Illumination.

More light in the eyes than on the work. Sharp shadows and much glare from the polished metal. Discomfort to the worker; loss to his employer. Danger of accidents. Many factories are too expensively, but very poorly lighted.

colored glass, but even the skin, to prevent the consequence of cancer. The eye also suffers from contrasts of light and shadows, as are seen particularly in rooms where furnace glares are mostly depended upon for lighting. Such conditions, of course, produce inaccuracies of execution, and lead to accidents, as well as curtailment

of production. Nystagmus, or dancing pupils, so commonly seen among coal miners, has been recently shown to be due essentially to poor lighting. The eyes are greatly fatigued by looking down constantly upon bright objects or reflecting surfaces. For instance, many persons suffer from headache when they look upon an expanse of river or lake water while the sun is shining. The retina of the human eye is normally adapted to high-lights (the sky) which come above the center of the field of vision, and to dark tones and colors in the lower field of vision. Looking down upon white reflecting surfaces, as upon paper, in ironing white goods, etc., is the cause of

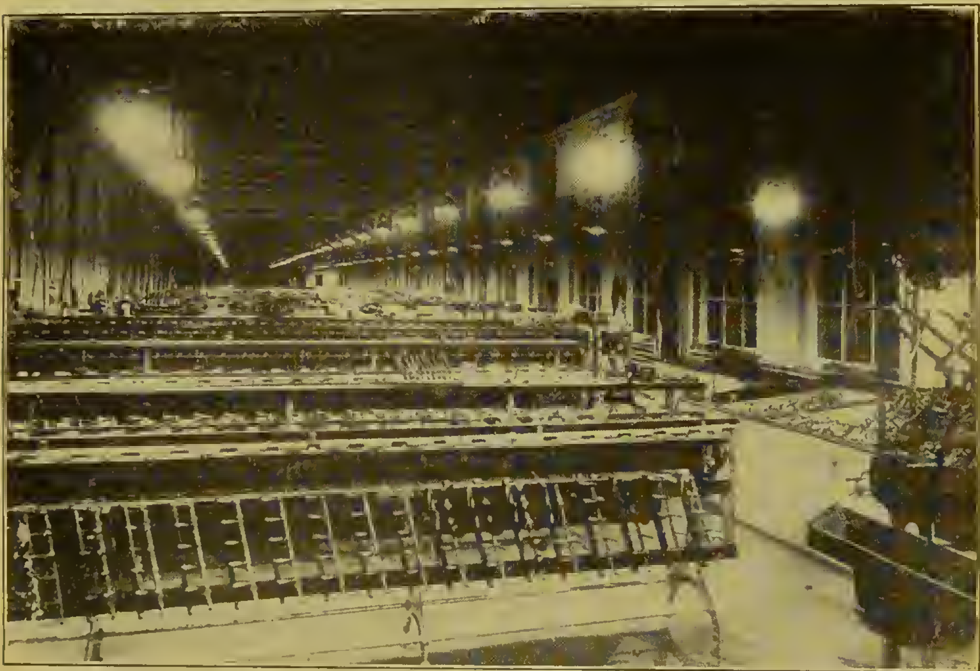

Fig. 7. Well Lighted Factory Room.
A factor in safety, health and production.

considerable industrial headache, much of which can be prevented by the wearing of eye shades or the use of dark glasses.

DAMPNESS. — Again, it is obvious to most persons that working continually in a damp place, particularly if within doors, is inimical to health. By dampness we mean not only moist, but wet places, steamy atmospheres, or air in which the humidity is maintained at a higher point than 65°. If, to such conditions, changes in temperature, either up or down from 68° take place, the risk to health becomes greater. Those whose work necessitates exposure to water and dampness should not be required to do sedentary work

unless temperature is carefully controlled, and recreation periods are arranged for. They should be provided with rubber boots, rubber aprons, etc., in addition to all mechanical means devisable to remove water and steam. Where other health-hazards are associated with this feature of dampness and moisture, workers should have bathing facilities, such as the shower bath, and obviously, such necessities as lockers for street clothing. Some establishments wisely provide drying rooms in which to hang damp working clothes.

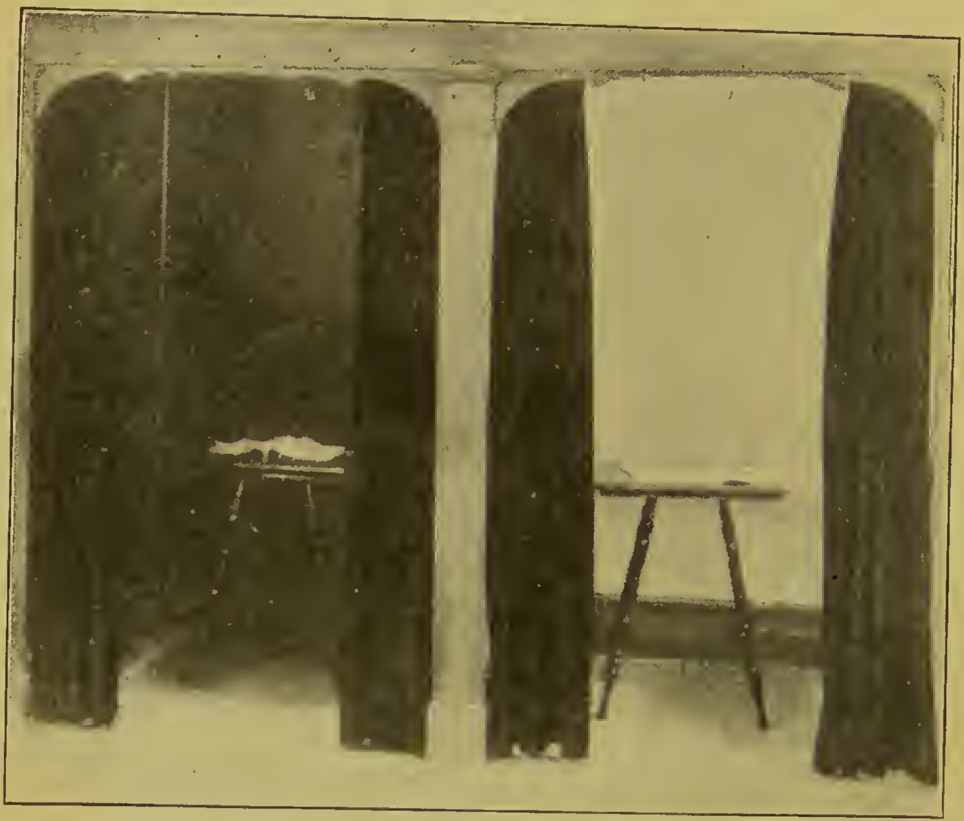

FIG. 8. DARK WALL SHADES AFFECT ILLUMINATION.
Each of these two little rooms receives the same light. Dark walls absorbed most of the light in left-hand room.

By far the vast majority of workshops and factories, however, are afflicted with the opposite condition, DRYNESS. An experiment made in almost any factory or workshop room, office or store, during the months of artificial heating will show that the relative humidity, instead of ranging between 60° and 70° for a temperature of 68°, is very much below this. This applies to nearly all steam-heated, hot-water heated, or hot-air heated quarters. This dryness of the atmosphere also promotes disease, first evinced as an irritation of the nose and throat, the glands of which are forced to produce extra

moisture in order to enable these parts to perform their functions. In time acute colds and contagions are easily acquired. Then there are chronic coughs, and, from this on, a large variety of disease conditions are possible. Humidifiers, air exchangers, and especially fans to keep the air in motion are urgently needed almost everywhere in indoor workrooms.

The readings of the wet-and-dry-bulb thermometer should regulate these conditions. This is a most valuable instrument, and should be placed in almost every place of human habitation, especially mill-rooms, work-rooms, offices, stores, school-rooms, etc., in the state. It records "sensible temperature", as well as actual temperature, and its humidity readings will surprise, many times, as well as explain why rooms seem stuffy and hot, or cold and damp when the ordinary thermometer is recording normal! There are several forms of the instrument. The sling psychrometer is best, but any of the stationary wall forms will suffice if the air is put in motion, as by fanning in front of them before taking a reading. The adoption of cloth windows in the lower frames of the ordinary window appears to be capable of solving this question to a large extent. It has been shown that a medium grade muslin cloth of light color retains heat much better than glass and permits an exchange of air and moisture almost unhampered, while light is, if anything, better diffused.

Fig. 9. Clay Preparation in Pottery Works.
Showing filter press room of model construction in an art tile plant.

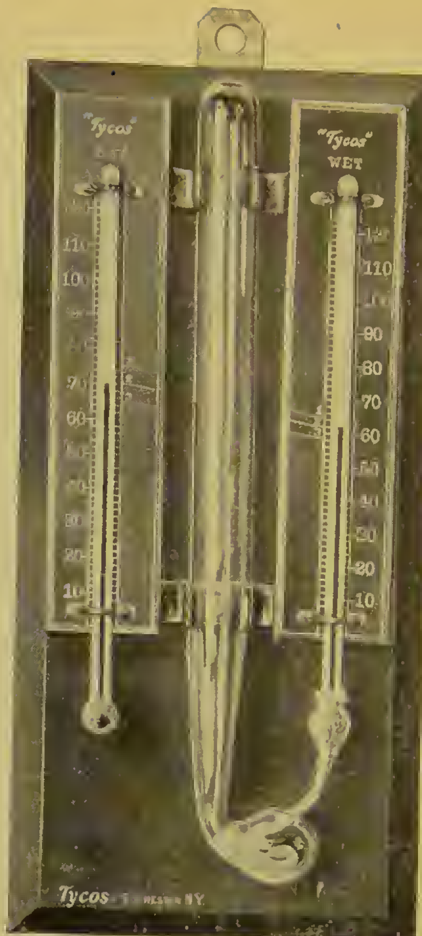

FIG. 10. THE WET-AND-DRY-BULB THERMOMETER.

This instrument gives relative humidity and "sensible" temperature. The most important health indicator made. A fan should be turned upon it to put the air in motion while taking a reading.

DEVITALIZING AIR.—Bad air conditions in work places may be due to (1) deoxidation (presence of flames, furnaces), (2) contamination (escaping gases, vapors, fumes), (3) pollution (dust smoke, moisture particles from other persons' breaths), (4) unnatural temperature-humidity relations, and (5) stagnation. Of these, stagnation probably does the most damage to the largest number of persons, since quiet, still, "dead" air fails to promote evaporations from the surface of the skin, and to stimulate the sensory nerve endings located in the skin, both of which are necessary to maintain a good circulation of the blood. This good circulation is especially needed for a large class of workers while engaged in their various trade processes. The essential difference between indoor and outdoor air is that the former is usually still, quiet, or "dead", while the latter is in motion, is fresh, and "alive". If to stagnation are added any of

the other four conditions above mentioned, as is often the case in work places, the danger to health is much increased.

Probably, abnormal temperature-humidity relations are next in hazard to stagnation as deleterious factors, although the physiology of the human organism can adapt itself to quite wide variations in these if the air can be kept in motion. A person can exist (at least experimentally) in comparative comfort in a closed-up closet for a considerable time if these last mentioned features — *temperature 68°, humidity (relative) 60°*, and a *motion of the air*, as by fans — are provided for. It has been practically established that it is not the amount of oxygen which persons use up in breathing, nor the

FIG. 11. SMOKE NUISANCE.
No fresh air possible within work places in this district.

amount of carbon-dioxide they exhale, nor the emanations from the human body (except moisture particles from the coughing, spitting or sneezing of diseased persons in crowded quarters) which count for aught in vitiating the air, except under the most unusual conditions of crowding or confinement.

There is a difference between the air of many work quarters, however, than that of homes, schools, offices, stores, etc. In shops, factories, mills, and many other establishments there are the ever-present air *vitiators* such as free flames without vents, gas heaters, salamanders, furnaces, gases from tanks and vats, and chemical vapors which are not confined or led away from the breathing atmosphere. To these are multitudes of wage-earners exposed as well as to air stagnation and temperature-humidity factors. Practically

all such vitiation can be corrected by various types of confining cupboards and enclosures, and by artificial ventilating systems, air-agitators, suction fans, etc.

Of all factors which tend to promote high death rates, particularly from the preventable causes, such as tuberculosis, pneumonia,

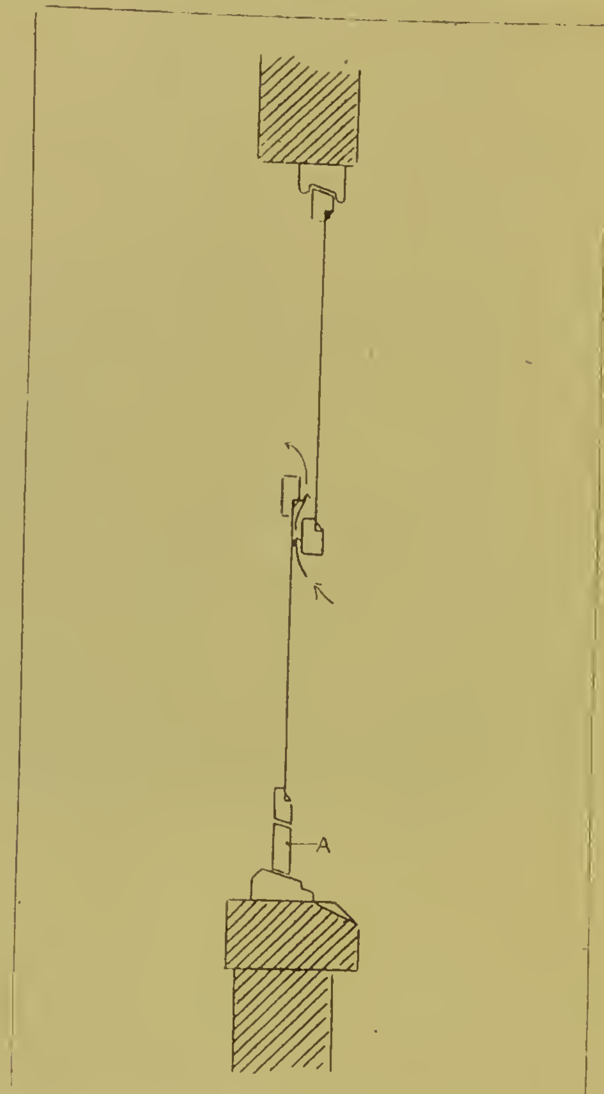

Fig. 12. To Convert an Ordinary Sash Window into a Ventilator.

Insert a board under bottom sash. It will be found that fresh air from outside will find its way into the room as indicated, with very little, if any, draft. This is a useful method for many workshops.

bronchitis, and the like, atmosphere which is not that supplied by nature, is paramount. We might say, in a word, that if the out-door air could be breathed by workers in all lines of activity throughout the work hours of the day, the preventable, degenerative and occupa-

tional diseases would be almost entirely done away with. In this respect, the person in a clerical position is just as much concerned as the operative in a factory or mill.

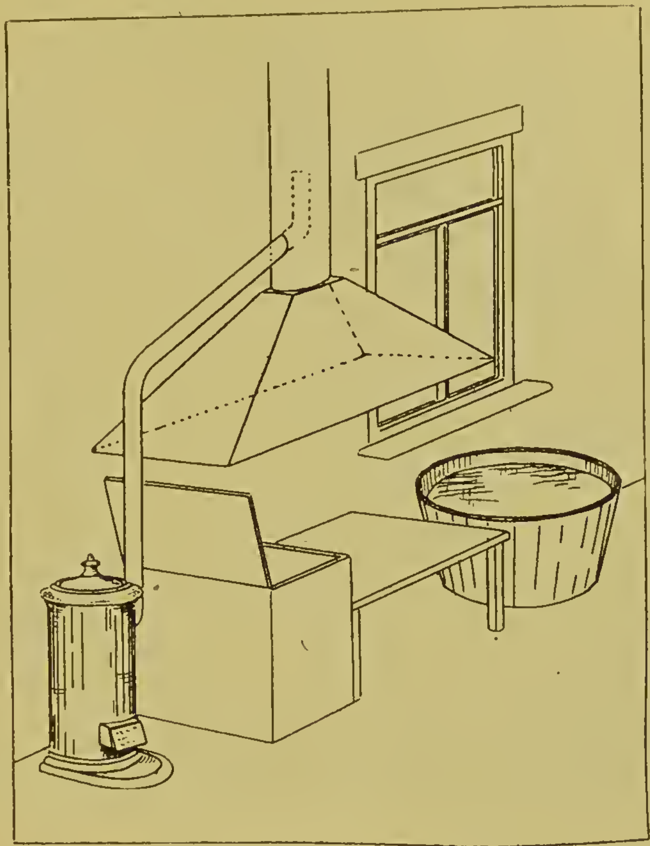

Fig. 12. The Elements of Exhaust Ventilation.

To collect the dust, vapors, or fumes which may arise from work processes a hood with stack is provided. The exhaust may be created by draft from a stove pipe (as shown), or a steam jet, or exhaust fan, or connection to a chimney of sufficient height.

HEAT. — The exposure to heat produces prostration, heat exhaustion, muscular cramps and acute colic when the effects are extreme, while in the long run it produces anemia, catarrh, rheumatism, Bright's disease, skin eruptions, gradual fibrosis and premature old age. Its effect upon the eyes has been commented upon under the head of DARKNESS. Many persons who are exposed to heat should wear glasses as much for protection against the heat as against the unnatural light which accompanies it. The raising of the body temperature, *thermic fever,* which takes place more or less constantly among heat-exposed workers, is accompanied by the production and accumulation of definite poisons or toxins within the body, which are

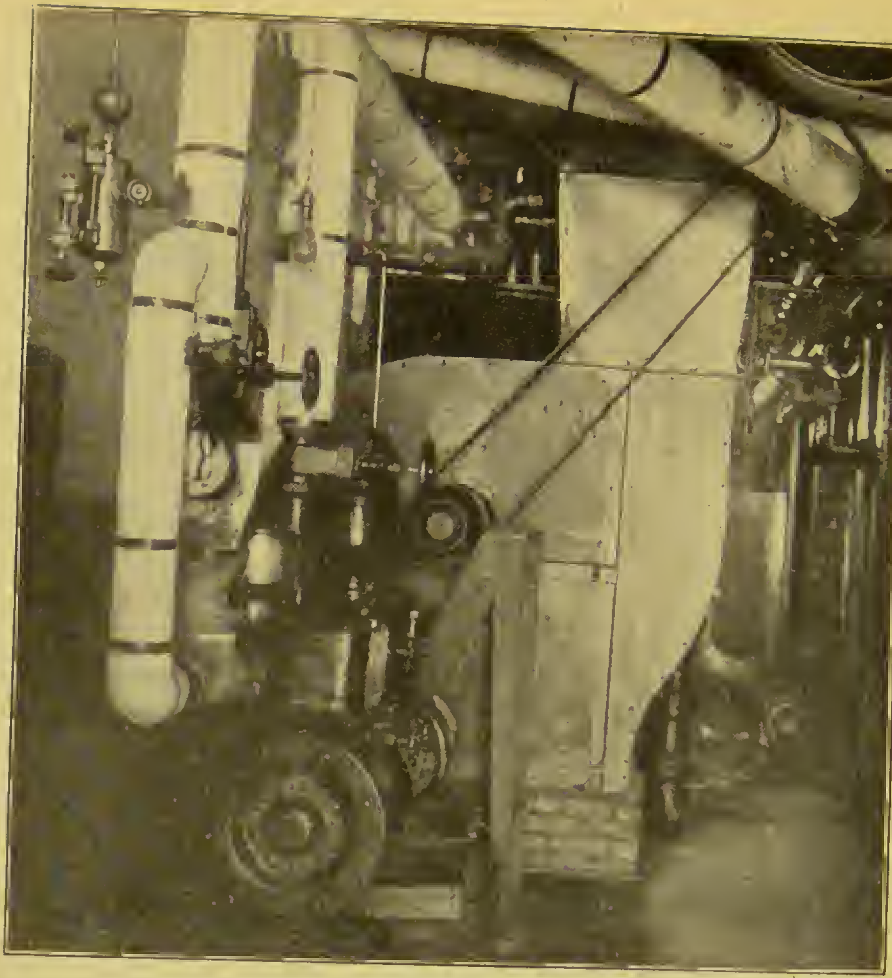

FIG. 14. AIR-CONDITIONING APPARATUS FOR FACTORY VENTILATION.

This machine washes, strains, humidifies, heats and cools the air as well as forces its circulation. It maintains the dew point within 1° of a fixed point for three floors in a large factory building.

responsible for the effects above noted. Hence he who shows effects of exposure to heat has been occupationally poisoned although the poison in this case has been elaborated within his own system. If combined with moisture, the effects upon health are still worse, since the failure of opportunity for the evaporation of the normal perspiration on the surface of the body is interfered with, thus disturbing, seriously, the heat-regulating mechanism.

In practically all trade-processes heat can be kept away from workmen, or means can be adopted to nullify its effects. The adoption of modern appliances for handling and transporting heated materials has done much in certain industries to solve this question. In addition, the use of shields and screens; of asbestos coverings; of water-cooled furnace doors; and particularly of airblasts, sufficiently

strong to blow back the heat currents, or, in some cases, to blow upon the exposed workman; the adoption of powerful electric fans; of water sprays; and so on, have done much toward helping it. Finally, we would mention particularly the short work day, and the frequent rest period, also the wearing of garments arranged to protect from the heat, but at the same time permit of evaporation. Then, one of the most important necessities for the use of all heat-exposed workers is the shower bath. There is a good physiologic reason for this.

FIG. 15. ELECTRIC FAN.

Portable ventilating fan shown at "C" with fan motor completely covered and "A" with shields removed. These fans are 36″ in diameter and are used where men work in high temperatures, and can be moved to suit conditions and obtain the best results.

which in plain terms may be stated to be that it tones up the pores (sweat glands) of the skin, decreases the perspiration, and re-establishes the circulation equally throughout the system. We may add to this that it cleanses the person and adds to the psychological effect which comes with self-respect, which in turn promotes health. Such bathing facilities will cut down rheumatism, lumbago, stiff joints,

colds, sore throat, etc., to a marked degree. It must not be forgotten that a person whose back muscles are full of "heat-toxins", which have not been properly removed by a good circulation, will, on the next day, when he returns to work, and upon slight straining effort, develop an acute "kink" in the back muscles, which becomes a lumbago that is as disabling, and takes as long to cure in many cases, as a broken hip. In connection with the shower bath, we would mention the necessity of providing, not a cold stone or cement floor upon which to step, but wooden treads or slats. Also all workers exposed

FIG. 16. THE REST INTERVAL FOR HOT PROCESS WORKERS.

Protection against heat. Men enjoying a fifteen minute rest between working spells at hot processes. These men are relieved in this manner every fifteen minutes while working in excessive heat.

to this hazard should, by all means, have a double set of lockers, one for street clothes, and one for work clothes, this latter arranged so that warm, dry air may dry out the clothing between work periods.

COLD. — Working in the cold cannot be said to be dangerous to health. One or two qualifications should be made: the worker should get enough exercise to stimulate circulation, he should be properly clothed, and should not be subjected to alternations of cold exposures with heat exposures. This is where the damage to health is done in the case of most workers so exposed. Human beings work in the frigid zones and keep perfect health. Combinations, however,

of cold with hazards such as dampness, darkness and vitiated air, are, of course, decidedly injurious.

A bad feature in many hot processes is that workers are exposed to all manner of cold drafts, especially during rest intervals and in the winter season. In this over-heated state they often step out of doors and sit down upon benches without putting on additional clothing. Oftentimes they are compelled to go to an outside privy or through cold halls and area ways to toilets located perhaps in damp cold basements.

Fig. 17. Sanitary Provisions in a Modern Steel Works.

In the rear are shower baths and, around sides, lockers with fronts permitting air circulation. (Shower) baths are a physiological necessity to all workers in hot processes.

FATIGUE. — Fatigue is one of the most common causes of occupational disability.* This is a prime cause of the fact that bodily development in factory classes remains inferior to that in other social classes. Fatigue is defined as loss of irritability and contractility brought on by functional activity. The sensation of fatigue is due to the accumulation of waste products within the system called fatigue poisons (definite chemical substances) and fatigue toxins. The poi-

* "So tired" is an expression which should never be heard from any worker at the close of his or her work day. It signifies exhaustion. — (*Sir Thomas Oliver.*)

sons are acidic in character. A fatigued muscle is acid in reaction, while one at rest is alkaline. Of the poisons, leucomaines are one type and are similar in action to ptomaines obtained from putrid meats. The presence of such substances is easily demonstrated, as for instance, in the dog experiment in which a few cubic centimeters of blood removed from the veins of a dog, which has been run until fatigued, and then injected into another dog, not previously exercised, within a few moments causes symptoms of fatigue to appear in the second animal; even paralyzing effects and, finally, death may follow after a period of extreme exhaustion. There are many other ways

FIG. 18. SORTING AND MARKING IN A LAUNDRY.

Note stools without back rests.—A fatigue factor among sedentary workers.

of demonstrating the presence of this fatigue substance. Fatigue poisons do not accumulate in the system if time intervals are sufficient for the circulation to counteract, and remove them between muscular efforts. These symptoms, when they appear, are usually not more prominent in the particular muscles or parts used than throughout the system in general. The brain, which is the source of motive power, always suffers in fatigue, no matter what part of the body is overworked.

Workers who begin a new process at first feel the symptoms of fatigue very quickly, but gradually the period of continuous ap-

plication is extended until, as we have explained, the person has become used to the work. This is more than the matter of the establishment of a good circulation of blood to the parts used, and the training of nerve-paths. It seems in part to be due to an anti-toxin carried within the blood which destroys the fatigue toxin at its source in the muscle. "Getting in training" is but the working up of this fatigue antitoxin.

Fatigue symptoms should never be permitted to exist in industries. These are, in a minor way, tiredness, sore muscles, stiff joints, aches and pains, etc., while in a more severe form we have such signs

Fig. 19. Ideal Working Conditions.

Sedentary work showing swivel chairs with backs and foot rests. Also lamps well placed and shaded. All are important factors against fatigue. Note machine parts protected to prevent accidents.

as muscular cramps, obstinate lumbago, wry neck, neuritis, neuralgia, and "occupational neuroses", in which any attempt to return to the regular work results in spasms of the muscles used, accompanied by soreness, constant aches and pains, trembling, gradual emaciation and partial paralysis of the parts. In time, ligaments weaken so that flat feet occur (perhaps with varicose veins, eczema and ulcers), round shoulders, bowed backs, and sunken necks. Internal organs drop downward (especially the kidneys and the female organs), causing much chronic invalidism. Such signs are usually accompanied

with a mental condition of anxiety which is out of all apparent proportions to what can be seen, and along with headache and constipation make up the disease condition known as "neurasthenia." Neurasthenia is practically always occupational. In females "hysteria" is a frequent associate. The next stage is "nervous breakdown". Many persons, of slightly unsound condition to begin with, develop a "fatigue psychosis", that is, insanity which may be sudden and violent, or just a gradual deterioration characterized as "played out", "no good any more", "can't make his day's wages", etc. Our hospitals, dispensaries, charities, various institutions and asylums are crowded full of these classes of persons. About 90% of them are over 40 years of age, which make a significant contrast with the age-group figures for wage-earners in manufacturing industries, about 90% of whom appear to be under 40 years of age.

Fatigue which affects the steady worker causes anemia, enlargement of the heart, increased blood pressure, circulatory diseases, kidney disease, and neurasthenia or nervous exhaustion. . This latter is a very common complaint of the working classes. Chronic fatigue predisposes to weakness and paralysis of special parts, and to nervous breakdowns. The general fibrosis of all organs and parts encroaches upon the reserve forces of these organs and parts. Premature old age is a consequence. During the course of any of these chronic affections, which are usually progressive when once incited, the person is predisposed to all manner of acute diseases, one of which, in the end, is finally signed upon the death certificate as the cause of demise.

Loud noises fatigue the ears, and are a common cause of partial or complete deafness. Cotton stuffed in the ears during work, and removed immediately afterwards greatly limits this deafness.

Young persons, particularly those under 18 years of age, are permanently and more seriously damaged by the poisons and toxins of fatigue than are those of maturity. This is because during the age-period from about 15 to 18 in boys, and about 14 to 17 in girls, a marked increase in growth should normally take place (greater than any other period of life, except the first two years of infancy), and, there is also, not only growth in stature, but a *concrescence* or "growing together" for firm union for adult life of the muscles, bones, tendons, etc., which are concerned in voluntary acts. Furthermore, the cartilaginous parts and junctions, are, during this age, finally replaced by bony matter. During this age-period, then, energies must especially be conserved for the functions of growth. Where fatigue substances are allowed to factor, growth is stunted, concrescence is inter-

fered with, and reserve forces so dissipated that there results deformities, weakened constitutions, and a greatly increased liability to the inception of chronic diseases, particularly of tuberculosis and organic heart disease.

FIG. 20. THE NORMAL POSITION OF THE FEET IN STANDING OR WALKING.

The toes should be pointed almost straight to the front, which gives strength to the arch of the foot, while the walker covers more ground for given muscular effort.

The fact that young persons' fingers are nimble, and their actions quick should not be taken advantage of by allowing disastrous exhaustion to lessen their vitality at this most important period of life.

FIG. 21. FLAT FEET.

This results from incorrect standing or walking, or prolonged standing (especially during youth or during a weakened condition).

Particularly does this apply to the permitting of piece-work, and monotonous or steady-straining processes. Also to night work, and to weekly alternation between night work and day work. If we add

to these deleterious fatigue toxins the poisons which are produced by exposure to heat, the disastrous results are usually more than double. Any who doubt this may consult the Vital Statistics Reports.

In a word, fatigue, or a tired feeling, means for all persons: Take a rest! The sensation is simply nature's warning. Rest, at least during the daytime, very rarely implies a cessation of voluntary activities altogether, but implies a change of work or process for a brief interval, by which strain is relieved and recreation is brought about. The entire cessation of voluntary activities, which normally occurs in the adult for a period of about eight hours during the night, is essential for the recreation of the vital organs, which, though in constant activity from the day of birth until the day of death, require about one-third of the time each twenty-four hours to compensate for the extra duties imposed upon them by the acts of voluntary activity.

In summing up the chief factors which cause fatigue in the steady workers — who, as we have shown above, should never show symptoms of exhaustion — there are (1) laborious work, (2) long hours, (3) piece-work, (4) speeding up, (5) monotony, (6) constant standing. (Constant standing upon cement, stone or brick floors should be provided against by supplying wood platforms or even plain boards upon which to stand. Correct methods of standing — the toes and heels parallel — should be taught). (7) constant strain, (8) chairs or stools without backs, (9) faulty postures, (10) jarring processes, (11) pressing or holding objects against the body, (12) eyestrain, (13) loud noises, (14) irregular hours for sleep, and finally, (15) the *absence of work variation* or periods of relaxation and recreation, which, in case of females, means, also, rest rooms.

INACTIVITY. — For a period of about 15 to 16 hours of the day, the average normal adult may remain awake and exercise for the most of the time his physical and mental equipments, provided there is diversity of application. This is essential to keep these parts in normal tone, but more especially to aid in the circulation of the blood and lymph, so that food products are properly assimilated, and waste products are properly eliminated. If such opportunity for exercising the voluntary functions is not given, there is a tendency for assimilating powers and processes, to surpass the powers of distribution and elimination. In common parlance this "sluggishness" produces self-poisoning. In reality gouty and other poisons accumulate, and produce damage to blood vessels and organs, not very dissimilar to the effects of fatigue-poisons.

Those persons who do sedentary work, whether at desks, at machines, or at benches all day, are, in a way, doubly poisoning them-

selves, first, through fatigue-poisons, due to the over-use of certain parts without rest intervals, and secondly, to the accumulation of poisons from a sluggish circulation due to general muscular and respiratory inactivity. Where monotony in work is a factor, it is physiologically necessary that workers be taught, and allowed to work at at least two different processes. *Frequent physical exercise is necessary to maintain health.*

FIG. 22. EXERCISE FOR THE OFFICE FORCE.

Once in the morning and once in the afternoon. A great stimulant for all inactive workers.

GERMS AND INFECTION. — Vast numbers of persons are exposed through methods and environments of work to infections, blood poisonings and communicable diseases. In the first place, (1) over-crowding in workshops enhances the spread of all communicable diseases. (2) the common use of towels, cups, wash basins, clothes, etc., spreads diphtheria, colds, tonsilitis, pneumonia, consumption, syphilis, trachoma (granulated eyelids), and any of the more strictly contagious diseases.

Other sources of industrial infections are (3) improper closets, (4) spitting upon the floors, (5) sweeping during work hours, or by dry methods, (6) absence of cuspidors, (7) the handling of infectious materials (hides, wiping rags, wool, oil, etc.), (8) the handling or

FIG. 23. TWO HEALTH PROTECTORS IN FACTORY LIFE.
The model cuspidor for factory use, showing "backstop" and floor protector, all easily cleaned. The garbage can is a sentinel for order and cleanliness.

FIG. 24. FIRST-AID KIT.
Each department of the plant should be supplied with a "First-Aid in Case of Accident" kit, which is conveniently kept in a glass jar.

mouthing of articles just previously handled or mouthed by another person, etc.

Infections are also invited through (9) frequent trivial injuries, (10) flying particles, (11) cracking or fissuring of the skin, eczemas, etc., due to the careless use of solutions, gases and vapors. Also (12) through calluses, which, when incised or punctured, as by slivers, etc., have very poor resistance to infection and subsequent blood poisoning, and to lock-jaw; hence, in this connection, the great value of "first-aid" to take care of the most trivial injuries, foreign particles in the eyes, etc., and (13) a surgical emergency room, and, for

Fig. 25. Needed in All Work Places.

Emergency equipment for first-aid to the injured. Prevents blood poisoning.

larger establishments, the presence of (14) a trained nurse, (15) a supervising physician and surgeon, and (16) hospital arrangements.

Smallpox, plague and other diseases have been spread by (17) the use of wiping rags, waste, etc., which, unsterilized, have come from almost anywhere. (18) Typhoid fever has proved a menace to thousands of workers in this state; in one place where strike-breakers were confined behind factory enclosures without proper sanitary arrangements; in another where the offal from a quarry district, which was almost without sanitary provisions, eventually polluted the water supply; etc. Trachoma has proven a serious

menace to factory districts, mostly (19) through housing conditions, and the question at once arises whether employers have not a right to demand certain standards in this direction, in return for the value of the money which is paid in wages.

Hookworm disease is liable to develop (20) among miners, tunnel workers, brick makers, quarrymen, construction-camp workers, lumber and saw-mill hands, where no closets or privies are provided, and especially in seasons of the year which permit persons to wear open or "holey" shoes, or go barefooted, or handle the earth directly. Obviously, typhoid fever is constantly to be feared under such conditions, with the added risk which contaminated water gives. Workers about animals (21) are liable to anthrax, glanders, cow-pox, milk sickness, lumpy jaw, hoof-and-mouth disease, catarrhal jaundice (Weil's disease), pemphigus, erysipelas and lock-jaw.

A *medical supervision* of workers in all places employing persons working in close quarters is essential. It will prevent much "industrial" tuberculosis. This should include (22) the *physical examination* of new employes, and careful thought given to the selection of workers from a health point of view. Further factors that will tend to keep down infections are the supplying of (23) gloves, (24) goggles, and (25) the posting of placards of instruction.

POISONS. — Workers in poisons are very liable to develop *specific occupational diseases* due to the particular poison to which they may be exposed. The extent to which poisons are used in the industries is enormous, and new industries utilize the same poisons in new and dangerous methods. As health-hazards, no poisons need to be dispensed with in industry, but what is necessary is that in their use as much attention be given to their effects upon health, both acute and chronic, as to the methods and purposes for which they are used.

The more common poisons used in the State of Ohio are about in order of their frequency of use and their liability to produce occupational disease: lead, benzine and benzol (naphtha, petrol, gasoline, etc.), turpentine and similar dryers, brass or zinc in the form of fumes; acids, alkalis, wood alcohol, analin oil, carbon bisulphide, antimony, illuminating and fuel gas, sulphurated hydrogen, arsenic, phosphorus and mercury. (The State Board of Health has a special pamphlet entitled "Industrial Poisons" which covers all of these poisons and many more. After naming and describing the poisons, the industries in which each is commonly used are given, and, finally, a concise description of the symptoms produced, as well as methods of preventing and treating such cases of poisoning.)

Occupational poisonings occur because the amount of risk is not appreciated by either employer or employe. Also, because of the physiologically impossible assumption that a person can "get used to" a poison. No metallic or inorganic poison can be absorbed in the human system without evidences of damage resulting. In fact, in this respect, arsenic and phosphorus are apparently the least harmful of all because they have, to a limited extent, alterative powers, if assimilated in very minute quantities. Even this much cannot be said for any of the other poisons mentioned in the above list. None can

FIG. 26. LEAD POISONING.

The black line due to lead is well shown on the teeth. It was also well marked *in* the gum margins.

be physiologically handled by the human body. *Their presence in the body is incompatible with the maintenance of health.*

A great mistake which is made in the conception of poisons is the question of mistaking toleration for habituation. The fallacy of this has been fully described in the beginning of this chapter. In a

FIG. 27. PARALYSIS FROM LEAD POISONING.

This man, aged 22, a kiln room laborer in a lead-works, was admitted to Cincinnati Hospital in the Spring of 1914, with acute lead poisoning. He rapidly recovered and was strongly advised upon discharge to keep away from any occupation dealing with lead. In spite of this he returned to his former work. After 6 weeks he returned to the Hospital (June 6, 1914) again suffering from lead poisoning and paraylsis of both wrists.

Fig. 25. Death from Lead Poisoning.

This man, aged 51, worked about one month as a lead-work's laborer in Cincinnati and was admitted on May 22, 1914, to the Cincinnati Hospital suffering from acute lead poisoning. He soon became delirious and violent and had to be shackled to his bed. He died in the hospital, June 23, 1914, his death certificate giving the cause of

word, toleration at least implies utilization of reserve force, and this always results in early decrease in capacity, with gradual fibrosis of the organs and parts, similar to that seen in old age. In addition to fibrosis, poisons invariably cause protoplasmic changes of destructive character in the vital organs.

Occupational poisonings will not cease until the following factors have been met and overcome: (1) keeping workers in ignorance of poisons used, (2) misbranding of poisons, (3) fancy branding of articles containing poisons, (4) lack of instructions, (5) disregard of instructions, (6) wrongful instructions, (7) harmful regulations, (8)

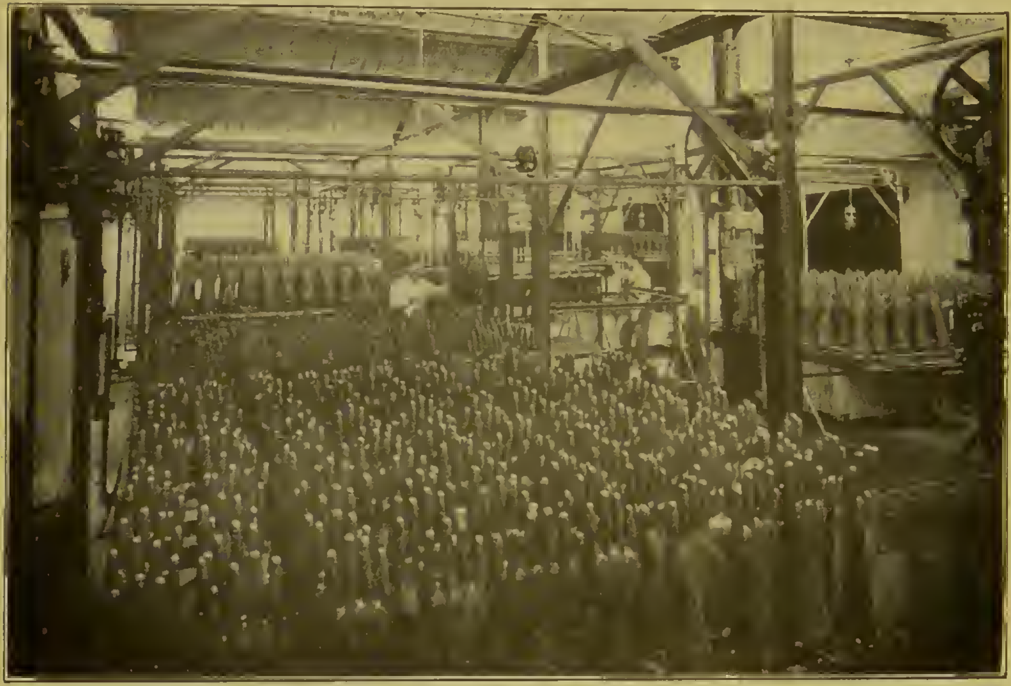

FIG. 29. MAKING RUBBER GLOVES.

Dipping Room. Benzine vats are covered between operations. Floor is exhaust-vented and fresh air forced in continually from above.

absence of medical supervision, (9) and of mechanical health appliances. Further, (10) the eating-at-work or in workrooms, (11) lack of personal cleanliness, — even the wearing of mustaches or beards are vital factors with some poisons. Finally, there must be considered, for given poisons, the use of (12) gloves, (13) respirators, (14) proper clothes, (15) lockers in outside rooms, (16) good washing facilities, (17) water closets, (18) eating places, and the development of inventions along the lines of (19) confining poisons, and possibly of the (20) substitution of certain poisons, by non-poisonous.

even though, perhaps, more expensive substances. This latter, we believe, is rarely, if ever, necessary.

One feature, if borne in mind, would do away with nine-tenths of all industrial poisoning, and would seem easy of accomplishment. This is to keep poisons from entering the system by way of the nose or mouth. The wearing of a respirator would seem to accomplish this as far as inhalation is concerned, but the question of preventing

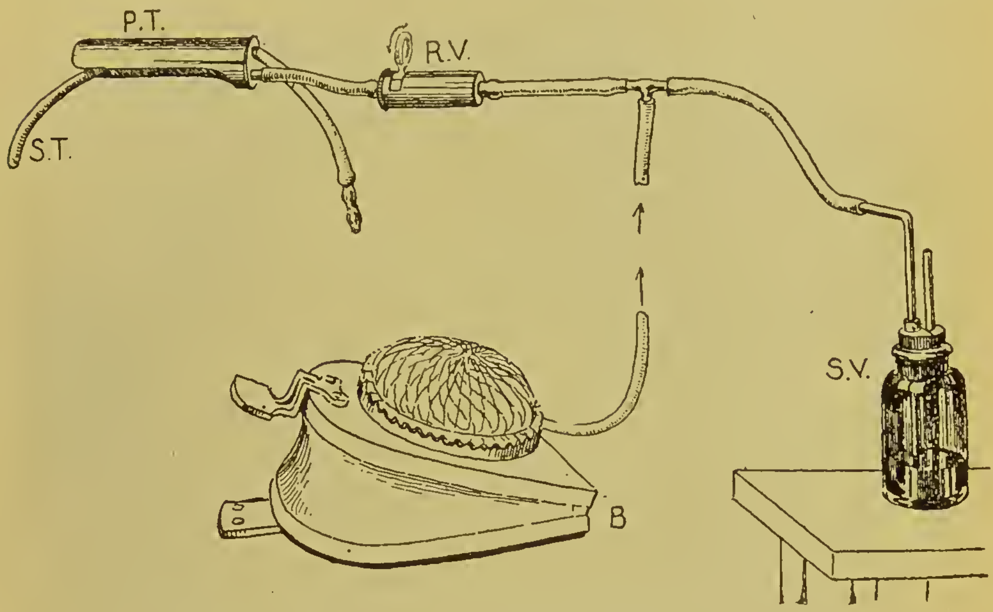

FIG. 30. THE MELTZER ARTIFICIAL RESPIRATION APPARATUS.

(Recommended by the Committee on Resuscitation from Mine Gases of the U. S. Bureau of Mines which disapproved of the pulmotor and other apparatus. *See* Technical Paper 77, U. S. Bureau of Mines).

The pharyngeal tube method. P. T., pharyngeal tube; R. V., respiratory valve; turning to the right brings an inspiration and to the left an expiration; S. V., safety valve (bottle should be shorter and wider) ; S. T., stomach tube (this may be omitted provided sufficient pressure is made on the abdomen to prevent gaseous distension of the stomach) ; B., bellows, (an oxygen tank may be substituted).

the ingress of poisons to the mouth, as from licking the lips, or using the uncleansed hands to put tobacco, or foods, or drinks into the mouth, seems to be almost impossible of accomplishment, hence the necessity of curtailing the amount of poisons by mechanical means to the utmost extent. In the end, a periodic examination of all workers in poisons is necessary in order to rid these industries of those who are unusually susceptible, or who cannot be made, or taught, to

follow instructions. The rotation of workers is another admirable means of meeting the situation, but this cannot be intelligently controlled without periodic medical examinations.

There are some *further health-hazards* in industries, some of which we will briefly mention. Working in COMPRESSED AIR, that is, in caissons, is one of these. So far as we know, very little work of this character was performed in the State during the course of our

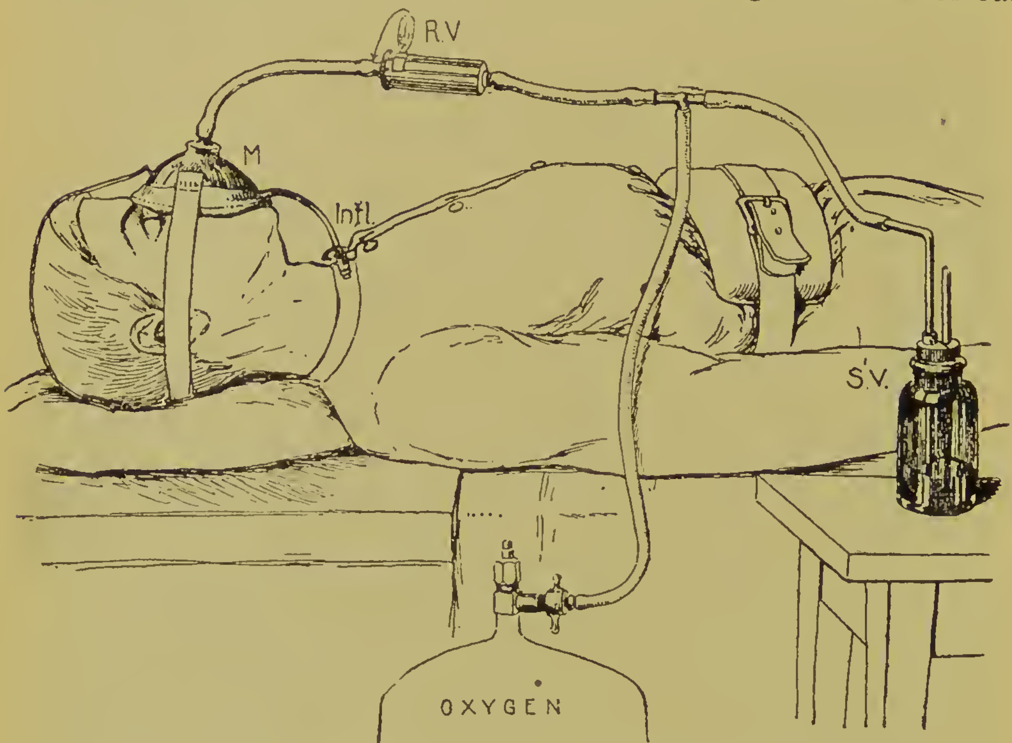

FIG. 31. THE MELTZER ARTIFICIAL RESPIRATION APPARATUS.

Face mask method. A well-fitting face mask may be used instead of the pharyngeal tube shown in figure 3. M., mask; Infl., inflation tube for inflating rubber ring around rim of mask; R. V., respiratory valve; S. V., safety valve. Insufflation pressure provided by oxygen tank. Heavy weights should be placed upon the abdomen. The pressure may be reinforced by a belt, or a belt pressing downward on a broad board may replace the weight. The belt alone is insufficient. The tongue should be pulled well forward by means of a proper tongue forceps.

survey. Suffice it to say that in bridge-building, tunneling, (particularly under water), and sometimes in the construction of buildings, it is necessary that the work be done under compressed-air. On the top, or in connection with all such caissons within which men have to work, should be provided air-locks within which workmen should be required to spend from 15 to 30 minutes at the close of each work period in order to undergo depression before coming out into the

normal air-pressure, and thus prevent the formation of air bubbles (air emboli) within the blood vessels, which, being carried to the vital organs, particularly the lungs, spinal cord and the brain, produce the symptoms called "the chokes", "the bends" and "the staggers". Such symptoms often result fatally, sometimes within a few minutes.

To a certain extent FOUL ODORS may be considered health-hazards, because of the nauseating effect which they tend to produce.

FIG. 32. SANITARY DRINKING FOUNTAINS.

Plenty of good water, properly cooled, in the workplace tends to limit alcoholism outside of the workplace.

Nausea is usually accompanied by an excessive secretion of gastric juice, which, in time, if continued, produces mucous gastritis. The condition especially invites alcoholism, but even by itself would result in emaciation and debility through loss of appetite and of the digestive powers. However, this is one subject in which the personal factor is uppermost. What is nauseating to one may prove quite inoffensive to another. To this question of odors, workers will usually select themselves of their own accord, before any material damage is done

to the system. In this connection we would mention especially the furnace odors so frequently complained of by workers around oil-blast furnaces, particularly when these are being started up as in the early morning of each day. For these persons, proper ventilation is essential.

Oftentimes indoor closets are installed in workrooms, without proper ventilation arrangements, perhaps only partially partitioned off with no ceiling over the same, so that odors escape and permeate the workroom. Some of the loudest complaints of the work people have been in connection with this type of an indoor closet. If much used, it is a constant source of irritation to the workers and productive of much bad feeling towards managements.

The acquisition of VENEREAL DISEASES through industry is possible through the common handling or mouthing of articles; through a lack of supervision where both sexes work together; and, through the unmindfulness of employers of generally immoral surroundings, such, for instance, as are created by questionable pictures, "wall writings',, loose language, etc.

The subject of ALCOHOLISM, as an industrial health-hazard, both as cause and effect, has been discussed in an early part of this section under the head of "Stimulantism."

PART IV.

THE INVESTIGATION OF INDUSTRIES IN OHIO.

The plan has been to make a hygienic survey of the principal manufacturing industries of the state. An idea of their type, extent and number of persons concerned can be obtained from the U. S. Census of Manufactures. Such a classification, however, is not well adapted to a hygienic survey, since a great mass of wage-earners may be employed in comparatively non-hazardous callings. Hence it is more proper to speak of health-hazardous processes than health-hazardous industries.

For our purposes, industries have been divided into six classes as follows:

(1) Those using poisons as a chief hazard.

(2) Dusty industries.

(3) Those in which fatigue and inactivity are the chief hazards.

(4) Those in which heat, cold, moisture, or dampness predominate.

(5) Those in which there is a more than usual liability to contracting communicable diseases.

(6) Industries having miscellaneous hazards not included above.

About half of the wage-earners of the state in manufacturing pursuits have been included in the industries investigated. In some instances strikes and business depressions interfered with the survey in certain lines of industry, but, outside of coal mining, not to any extent. The survey has not included non-manufacturing pursuits, such as general construction work, mercantile and trade pursuits, transportation, agricultural, animal, forestry and personal service pursuits, and those callings which engage professional, semi-professional and clerical persons. There are a number of manufacturing industries and processes, of course, which the survey was unable to get to because of limitations in time and funds, but those described constitute the principal ones and represent the vast majority of wage-earners. In this Part, then, are described, in a general way, the industries investigated, and the extent to which they have been surveyed, as well as the types of health-hazardous processes found to exist in them. The description of these processes will be taken up in the next Part. It will be seen that irrespective of the number of industries and the number of trades, health-hazardous processes are

comparatively few in number. From a hygienic part of view, many trades and callings are so similar that they can be grouped together under one common head. Any peculiarities, due to certain trades or operations, are described when they occur.

A large class of wage-earners are simply doing factory work. Such have been classified under the head of "factory processes" in the next Part. Except for dexterity, which experience develops, all such work is unskilled labor. This is the most convenient heading under which to describe the hazards of many processes which involve routine machine operations and hand work, such as assembling, inspecting and finishing of products. Every survey has a limit to the fine subdivisions into which it may go. It was the intent originally to make investigations which would cover 1/10th of the wage-earners in each particular industry, guided, of course, by the relative hazards of such industries. Later, this was reduced to 1/5th of the total wage-earners, as given in the U. S. Census of Manufactures for the State of Ohio (1910). It will be seen, however, that in many instances the survey has considerably passed this mark, even to the extent of reporting upon more places and more workers than the census figures give for the totals. In all cases our figures are limited strictly to the wage-earners, and do not concern office and managerial forces.

To make the survey representative and fair, the aim has been to investigate large, medium sized and small plants in all industries reported upon, and to carry the investigation of each industry into small cities, and even villages, in different parts of the state, as well as to include the large cities.

To anyone who has perused the previous sections of this report (Parts I, II, and III), it will be seen that any establishment employing workers at regular applications is certain to have some health-hazardous situations, even though naught but general factory processes are engaged in. The question with the survey has been the methods used, if any, to circumvent all such hazards to health. The prime object of the survey has been to lay bare the industrial conditions which are inducing or promoting the preventable and degenerative diseases pointed out in the tables given in Part II and Part VI.

Almost invariably our representatives, after presenting their credentials at the various establishments have been most courteously received. It is only fair to state that managements not only tolerated our investigations, but in 95% of instances, at least, did everything in their power to enable us to get at the facts, often at considerable inconvenience to themselves and the loss of valuable time. Our

investigators always came unannounced. Itineraries were so arranged that none knew where nor when these inspections would be made. Hence conditions were seen as they really were, in, we believe, all instances. It is necessary to say that in many places certain hygienic improvements were under contemplation, or under way at the time of investigations, so that any subsequent survey would probably find them better. Unquestionably, in many instances our own investigations, without necessarily intending to do so, initiated hygienic improvements.

The investigators, unless upon special missions, inspected all plants from basement to loft, where wage-earners were employed, inquired freely into the nature of processes, and endeavored to get at all facts which had any bearing upon the health of the wage-earners, both good and bad. For each plant a summarized report was made, covering the following features: character of business, total employes, total wage-earners (males; females; youths, 16 to 20; and minors under 16), trade processes, mechanical health appliances, health instructions and placards, benefit organizations covering sicknesses, pensions and death, general sanitation features covering toilets, washing facilities, shower baths, time allowance for washing, change rooms, lockers, clothing and by whom supplied, rest rooms for females, luncheon quarters, seasonal influences, welfare work outside of the factory, and the general appearance and contentment of the workers. (For the hygienic features of special processes see Part V.)

In connection with some of the industries, here described, are various vital statistics which have been available. Only such have been used whose source is authentic, and then only such figures as are large enough to mean something. One fault which oftentimes employers, as well as others, fall into is that of quoting a few instances, and attempting to draw general conclusions therefrom. For instance, it may be shown that in a given process ¼ of the workers have remained so engaged for years without apparent health effect. The fallacy lies in not being able to state what has happened to the other ¾ of the wage-earners who have been employed. Instances are known where, of 10 persons employed, 2 have remained steadily, while in the course of a year's time, 50 different individuals worked in the remaining 8 places, nearly all leaving because of health complaints.

An especial appeal is made to employers to keep sick records. We are glad to say that this is now done by some of the most progressive establishments. Such records should include, not only absences due to sickness, but all health complaints reported to foreman or others, not only concerning the work, but of any or every nature.

Employers are not hygienists nor physicians as a rule, and if they attempt to judge upon the relationship between these complaints and work they make mistakes. It is only natural, also, that certain features bearing upon the conservation of public health should escape the notice of the layman, or appear too trivial to warrant attention. Right here is where an establishment would be immensely benefitted through the services of a good physician. The physician could, at intervals, go over the records of absences, sicknesses, and health complaints, and suggest many remedies. In all processes involving the handling of poisons, and in trades in which the known death rate from preventable diseases is high, especial attention should be given, such as a physical examination at the time of employment, and a health inquiry at intervals thereafter. In poisonous industries, for instance, a five minute health inquiry, by a physician, of each worker about once a month would be all that is usually necessary. Furthermore, the physician is a very good person through whom to get to the employes. His services, although only occasionally employed, would be of immense help to the employer, not only in the supervision of the health of his employes, but in instilling the principles of personal hygiene among them, and in overcoming indifferences to efforts which employers and others may make in this direction. There is no sadder picture than the employer whose welfare efforts have been unappreciated, misunderstood, and, perhaps, scoffed at by his employes, until he has dropped his well-meaning intentions, locked up his shower baths, speeded up his machinery, and, perhaps, lengthened the workday. The reason for this is that along with every improvement must go education. Education in industrial hygiene is a part of the responsibility of the employer. There is no better man to help him out in this situation than the occasional services of a physician who is well respected in the community.

DEFINITIONS.

Industry. — Any single branch of productive activity; as, the iron industry, the soap industry, etc.

Establishment.—A place of business with its buildings, grounds, equipments and personnel.

Plant.—Same as "establishment".

Place.—In Parts IV. and V. this word is used very often and is a shorter term for the word "establishment".

Department.—Branch of an establishment, especially when such is located in quarters by itself; as, painting and varnishing department, foundry department, etc.

Process.—Particular trade, calling or manipulation; as, painting process, pickling process, etc.

An *industry* is represented by many *establishments* (plants or places), each of which has several *departments,* while in each department there may be one or several *trade processes,* each engaging a number of *wage-earners.* Wage-earners engaged in similar trade processes usually are subjected to similar *health-hazards,* while if there are several trade processes in the same department, wage-earners may be subjected to the health-hazards of other processes than their own.

A RUBBER COMPANY'S REPORT.

The following tables (abbreviated) show what one rubber company, employing some 650 workers, accomplished in the winter of 1913-14 in the matter of Illness Records, Physical Examinations and Sickness Records of their employes:

"We find that there was a total of about 380 examinations at the regular examination and since that time the total has risen to 443. Now out of these 443, the items show as follows:

I. *Last illness* ran the whole list almost, malaria predominating with 6, measles 5, penumonia 4, rheumatism, pneumonia, sore throat, stomach trouble, typhoid, scarlet fever.—Only 45 cases, all told, of close enough dates to report, that is within the last four years.

II. *Physical Examination Finding:*
Eyes: Vision, right 5, left 5.
Hearing: Right 2, left 2.
Chest and contained organs:
A total of 19 cases:
Heart Diseases, 12.
Arterial Sclerosis, 6.
Pleurisy, 1.
Abdomen and contained organs—44 cases:
All pertaining to hernia.
Rectum and Genito-urinary organs—28 cases:
Varicocele, 27.
Hydrocele, 1.
Mental Alertness, poor—6 cases:
Illiterate—10 cases:

"In the case of the hernial cases, above mentioned, with the exception of probably a dozen, they were very slight and these were or are now all properly supported by truss so that they cause no inconvenience. There were probably a half dozen cases of varicocele, and the hydrocele was bad. These cases were all instructed to wear proper support to prevent aggravation of the trouble.

III. Following is a list *showing Hospital information for months designated,* there being no major illness cases, and with but one or two exceptions, all parties returned to work immediately:

November (1st month of Hospital)

Illness cases 93 — Male 61, Female 32.

These cases included migraine, toothache, throat affection, in the most part, with a number of other trivial diseases.

Surgical cases 177 — Male 156, Female 21.

Mostly contusions, abrasions, infections from scratches, and sprains, nothing serious, excepting one contused heel and one elbow abrasion and puncture, both cases reported to State.

December.

Illness cases 57 — Male 26, Female 31.

Practically same as November.

Surgical cases 61 — Male 51, Female 10.

Same as for November, excepting one crushed hand, one hand and leg injured, one side bruised, all reported to State Commission, the crushed hand having to be amputated.

January, 1914.

Illness cases 77 — Male 38, Female 39.

Same as former months.

Surgical cases 72 — Male 64, Female 8.

Usual, two cases reported to State, neither being serious.

February.

Illness 118 — Male 67, Female 51.

Surgical 42 — Male 39, Female 3.

Two cases reported to State, neither being a major accident."

There is no question but that from the manner in which the *superintendent of this firm* has taken hold of the question of *physical examinations* and *medical records* of his employes, he is getting together a working force which is superb, one in which the defective worker is properly fitted to his job (not discharged), and one in which the constant repetition of minor health complaints are having their causes discovered and (whether occupational or not) these causes eliminated when preventable.

A prominent eastern establishment has been able to improve cases of heart disease by selecting proper work for such persons, not only saving lives thereby, but keeping worthy and productive men on their jobs.

A large steel company, which employed an average of 5,602 workers during a period of 38 months, supplied us with very carefully compiled tables of sickness taken from its sick benefit association records, which covered all employes. (No accidents, or venereal diseases included.) In all cases workers were genuinely sick for at least one week. Classifications showed as follows:

I. General Character of Sickness in an Iron and Steel Establishment.

Sickness.	*No. Claims.*	*Yearly Percentage.*
Preventable diseases	1,150	5.750
Degenerative diseases	227	1.135
Other diseases	67	.335
Total	1,444	7.220

II. Systemic Classification of Sickness in an Iron and Steel Establishment.

Systematic Diseases.	*No. Claims.*	*Yearly Percentage.*
Respiratory[1]	391	1.955
Digestive[2]	285	1.425
Communicable[3]	218	1.090
Musculo-osseous[4]	184	.920
Nervous[5]	79	.395
Skin[6]	65	.325
Circulatory[7]	63	.315
Urinary[8]	45	.225
Strain, etc.[9]	41	.205
Constitutional[10]	27	.135
Special Senses (ears, 15)	17	.085
Chronic Infections	18	.090
Lymphadenoid	6	.030
Neoplasms	5	.025
Total	1,444	7.220

[1] Bronchitis, 145; Pneumonia, 75; Tuberculosis, 51; Pleurisy, 39; Tonsillitis, 34; Miscellaneous, 47.

[2] Gastritis, 102; Appendicitis, 53; Liver Trouble, 34; Enteritis, 30; Indigestion, 19; Miscellaneous, 41.

[3] La Grippe, 100; Typhoid Fever, 72; Mumps, 10; Measles, 9; Misc., 27.

[4] Rheumatism, 141; Lumbago, 37; Miscellaneous, 6.

[5] Sciatica, 18; Neuralgia, 13; Neurasthenia, 12; Neuritis, 9; Paralysis, 8; Miscellaneous, 19.

[6] Boils and Carbuncles, 40; Conjunctivitis, 9; Miscellaneous, 16.

[7] Heart Trouble, 31; Varicose Veins, 13; Apoplexy and Cerebral Hemorrhage, 8; Miscellaneous, 11.

[8] Kidney Trouble and Nephritis, 39; Cystitis, 6.

[9] Hemorrhoids, 16; Hernia, 13; Heat Prostration, 4; Miscellaneous, 7.

[10] Auto-intoxication, 24; Diabetes, 3.

III. The Average (Yearly) Morbidity Figures in the Various Departments of an Iron and Steel Establishment During a Period of 3 Years, 1911 to 1913 Inclusive.

(The greatest variation of numbers employed did not exceed 15% in any one department.)

Departments.	*Average Number of Employes.*	*Average Number Sick.*	*Average Per cent Sick.*
(a) *Heat Exposed.*			
Bessemer	393.3	33.	8.39
Open Hearth	145.3	7.	4.81
Rail and Shape Mill	500.	43.3	8.66
Blast Furnaces	261.	35.	13.41
Foundry	163.3	12.7	7.77
Shelf Mills	348.3	33.3	9.56
Pipe Mill	1,764.7	162.	9.18
(b) *Weather Exposed.*			
Police	35.	2.7	7.62
Railroad (yards)	156.3	9.	5.76
Section Hands	110.	10.	9.09
Yard Labor	468.	28.7	6.13
Ore Docks	90.3	8.3	9.19
Bricklayers	72.7	2.7	3.66
Building Construction	106.3	9.7	9.07
(c) *Indoors* (mostly).			
Mechanical	472.3	47.7	10.09
Electrical	181.3	4.3	2.37
Miscellaneous	351.6	11.3	3.21
Total	5,619.7	460.7	8.20

The above tables are very important—

First, because they show the type and the minimum amount of sickness that can be expected at the present day in an iron and steel establishment which has the highest attainments in sanitation and hygiene of working quarters, and medical supervision of its employes.

Second, because the last table (No. III.) shows definitely which departments have the most and which have the least percentage of cases of sickness, and hence where the greatest precautions are necessary.

Third, because average sickness figures are shown for a number of "weather exposed" groups of workers who are under organized welfare and medical supervision—figures hard to obtain for these classes. It may be added in conclusion that a large percentage of these workers are foreigners, Eastern European, and therefore the most difficult class to instruct and supervise, but a strong overseers'

and foremen's organization with high ideals, patience and persistence has developed a working force in a health-hazardous line of industry in which the average yearly sickness is only 8.2 per cent. (The statistics supplied give the exact types of sickness in each department, but the necessarily small numbers for each disease do not make it advisable to publish the same here. Suffice it to say that respiratory and digestive diseases lead in practically all departments.)

INDUSTRIES HAVING A KNOWN ASSOCIATION WITH THE USE OF POISONS.

(See Part V and the general index for description of the health-hazardous processes mentioned. It is, of course, undersood that many hazards other than poisoning exist in the various industries here listed.)

AGRICULTURAL IMPLEMENTS.

According to the Census there are 55 firms employing 5,997 wage-earners, or 1.3% of the total wage-earners in the State. Our investigations covered 12 plants, in 6 cities, employing 4,560 wage-earners, of whom 4,499 were males and 61 females. The industry is made up of several processes which are more or less health-hazardous, viz., Iron Founding, Brass Founding, Core Making, Metal Grinding, Forging and Blacksmithing, Machine Shopping, Polishing and Buffing, Wood-working, Painting.

AUTOMOBILES, INCLUDING BODIES AND PARTS.

This industry, according to the Census, includes 75 establishments, employing 12,130 wage-earners, or 2.7% of the total wage-earners in the state. Our investigations covered 34 firms, in 10 cities, employing 17,783 wage-earners, of whom 17,404 were males and 379 were females. The industry is made up of several processes which are more or less health-hazardous, viz., Iron Founding, Brass Founding, Core Making, Metal Grinding, Forging and Blacksmithing, Machine Shopping, Brazing, Soldering, Welding, Polishing and Buffing, Acid Dipping, Pickling, Furnacing, Tempering, Electroplating, Painting and Varnishing, Japanning, Enameling, Lacquering and Shellacing.

BABBIT METAL AND SOLDER.

The Census shows 6 firms employing 74 wage-earners. Our investigations covered 2 firms, in 2 cities, employing a total of 8 wage-earners, all males.—Furthermore, babbitting of journal bearings is

an auxiliary process in railway shops, and many large plants in the foundry and machine shop, and iron and steel branches of industry.

One of the two plants visited had melting pots well hooded, so that risks from lead poisoning were only nominal. General working conditions were fair. The other plant had no devices for removing lead fumes. Foreman admitted trouble from lead poisoning in the past. General conditions of working very poor. One case of lead poisoning was seen.

BICYCLES, MOTORCYCLES AND PARTS, AND SEWING MACHINES, CASES AND ATTACHMENTS.

The Census gives 10 establishments engaged in this industry, employing a total of 4,773 wage-earners, or 1.1% of the total wage-earners in the state. Our investigations covered 3 establishments, in 3 cities, employing a total or 2,795 wage-earners, of whom 2,685 were males, and 110 were females. The chief processes of health-hazardous character were found to be: Brass Founding, Forging and Blacksmithing, Machine Shopping, Brazing, Tempering, Metal Grinding, Polishing and Buffing, Acid Dipping, Electroplating, Wood-working, Painting and Varnishing, and Enameling.

BOXES, FANCY AND PAPER.

The Census reports 46 firms employing 2,530 wage-earners, or 0.6% of the total wage-earners in the state. Our investigations covered 4 firms, in 4 cities, employing 581 wage-earners, of whom 351 were males and 230 females. Outside of general factory processes the industry was found to have the following processes of health-hazardous character: Wood-working, Gluing, Painting and Varnishing, Shellacing and Lacquering, Staining, Bronzing, Printing.

BRASS AND BRONZE PRODUCTS.

The Census shows 82 firms in this industry, employing 2,232 wage-earners, or 0.5% of the total wage-earners in the state. Our investigations covered 55 firms, in 6 cities, employing 4,532 employes, of whom 4,450 were males, and 82 females. The industry consists of several health-hazardous processes, of which the following are the chief: Brass and Bronze Founding, Core Making, Metal Grinding, Polishing and Buffing, Machine Shopping, Forging and Blacksmithing, Soldering, Brazing, Furnacing, Pickling, Acid Dipping, Electroplating, Painting and Varnishing, Shellacing and Lacquering, Enameling, Japanning. In addition, some plants were concerned in Iron Founding.

According to the Vital Statistics Reports for the State of Ohio, for the years 1910, 1911 and 1912, there were reported 43 deaths of Brass Molders and Brass Workers, of whom 14 died of pulmonary tuberculosis, or 32.72% of their total deaths. While the number of total deaths reported is small, the high rate of consumption is in harmony with observations concerning this industry reported elsewhere. This rate is to be compared to the pulmonary tuberculosis death rate of all occupations in the state combined, for the same years, which was 13.3%, and is also to be compared to the pulmonary tuberculosis death rate of those engaged in Agricultural Pursuits during the same period, which was 7.13%.

Tables submitted by the General Secretary-Treasurer and Editor of the Brassworkers' (Metal Polishers, Buffers, Platers, Brass and Silver Workers) Union of North America for the 5 year period from 1909 to 1914, covering the death claims paid, show the chief causes of deaths, numbers and percentages to be as follows:

Cause.	*No.*	*Per cent.*
Tuberculosis	77	31.9
Pneumonia	31	12.9
Heart Disease	31	12.9
Violence (including 6 suicides)	19	7.9
Other preventable deaths	20	8.0
Other Deaths from Degenerative Diseases	57	23.5
Permissible deaths	7	2.9
Total	242	100.0

The following quotation is from the letter accompanying the tables:

"You will note from the report, the large percent of our members that die from Pulmonary Tuberculosis. All of these deaths we believe were contracted by working at this trade, but the sad feature is that at least 95% of those that contract Consumption, working at our dangerous trade, will not acknowledge they have the disease until they are too far gone for recovery. They then quit the trade and try to get a position out in the air, often as collectors, driving laundry wagons, or a farm, or, if fortunate enough, go West. These we believe eventually succumb to the disease contracted while working at the trade. We lose all track of them and have no record. If it were possible to keep this record, the percentage of deaths in our trade would be enormous."

The average (median) age at death of the 242 brassworkers was 40.1 years, while for those who died of tuberculosis it was 37.27 years. (Since this is a long-period occupation the median age at

death has some significance.) Hence occupation cut off about 21 years from the expected life of each worker when he began to learn the trade at 16 to 18 years of age.

CARRIAGES, WAGONS AND MATERIALS.

The Census shows 407 establishments engaged in this industry, employing 8,815 wage-earners, or 0.2% of the total wage-earners in the state. Our investigations covered 53 establishments, in 11 cities, employing a total of 2,484 wage-earners, of whom 2,443 were males and 41 females. The chief processes of health-hazardous character were found to be: Wood-working, Forging and Blacksmithing, Machine Shopping, Metal Grinding, Acid Dipping, Electroplating, Shellacing and Lacquering, Painting and Varnishing, Staining, and Upholstering.

CARS MADE BY RAILROAD COMPANIES.

The Census shows 71 establishments employing 20,728 engaged in both the construction and repair of cars by steam railroad companies, and 49 establishments employing 1,318 wage-earners engaged in general shop construction and repair by street railroad companies. The two classes combined employ 4.9% of the total wage-earners in the state. A large amount of this work is carried on in the open, or in very openly constructed buildings. The vast percentage of it is general repair and round-house work, in which health-hazards are only nominal. Our investigations covered 6 establishments, in 4 cities, employing a total of 5,534 wage-earners, all males. The chief health-hazardous processes were found to be: Forging and Blacksmithing, Brass Founding, Machine Shopping, Soldering, Tinning, Storage Batteries (repairing), Wood-working, Painting and Varnishing, Shellacing and Lacquering, Welding, Babbitting.

CARS NOT MADE BY RAILROAD COMPANIES.

The Census shows 10 establishments so engaged, employing 3,016 wage-earners, or 0.7% of the total wage-earners of the state. Our investigations covered 7 firms, in 7 cities, employing a total of 6,464 wage-earners, of whom all except 5 were males. The chief health-hazardous processes were found to be the same as for Cars Made by Railroad Companies *(v. s.)*.

CASH REGISTERS AND CALCULATING MACHINES.

The Census shows 8 establishments so engaged, but the number of wage-earners is not stated. Our investigations covered 5 estab-

lishments, in 2 cities, employing 7,472 wage-earners, of whom 6,940 were males and 532 females. The chief processes of health-hazardous character were found to be: Brass Founding, Forging and Blacksmithing, Machine Shopping, Metal Grinding, Polishing and Buffing, Tempering, Pickling and Acid Dipping, Electroplating, Sandblasting, Wood-working, Painting and Varnishing, Shellacing and Lacquering, Electrotyping, Printing.

CHEMICALS.

The Census gives 33 establishments engaged in the manufacture of chemicals, employing 1,132 wage-earners, or 0.3% of the total wage-earners in the state. Our investigations covered 4 establishments, in 3 cities, employing 1,101 wage-earners, of whom 1,100 were males and 1 a female. The balance of the establishments are small firms. The following were found to be the chief health-hazardous processes of this industry: Chemical Manufacturing, Forging and Blacksmithing, Machine Shopping.

COFFINS, BURIAL CASES AND UNDERTAKER'S GOODS.

The Census gives 24 establishments engaged in this industry, employing 1,245 wage-earners, or 0.3% of the total wage-earners in the state. Our investigations covered 8 firms, in 5 cities, employing a total of 922 wage-earners, of whom 745 were males and 177 were females. Some of these establishments make only wood coffins, others metallic burial vaults and metallic coffin trimmings. The following processes were found to be the chief ones of health-hazardous concern: Founding (see Brass), Metal Grinding, Polishing and Buffing, Machine Shopping, Welding, Soldering, Electroplating, Engraving, Woodworking, Sewing, Painting and Varnishing, Shellacing and Lacquering.

COPPER, TIN AND SHEET-IRON PRODUCTS.

The Census gives 221 establishments engaged in this rather ambiguous industry, employing a total of 6,598 wage-earners, or 1.5% of the total wage-earners in the state. Our investigations covered 8 establishments, principally tin can and galvanized can manufacturers, which we have classified under this heading, located in 5 cities, employing a total of 1,307 wage-earners, of whom 840 were males and 467 were females. The chief processes of health-hazardous character were found to be: Tinning, Galvanizing, Soldering, Machine Shopping, Welding, Polishing and Buffing, Acid Dipping, Pickling, Electroplating, Painting and Varnishing, Enameling, Japanning, Lithographing.

CUTLERY AND TOOLS.

The Census gives 70 establishments engaged in this industry, employing a total of 2,820 wage-earners, or 0.6% of the total wage-earners in the state. Our investigations covered 25 establishments, in 6 cities, employing a total of 4,202 wage-earners, of whom 3,949 were males and 253 were females. The chief processes of health-hazardous character were found to be: Brass Founding, Iron Founding, Forging and Blacksmithing, Tempering, Welding, Furnacing, Hot Shaping (Iron), Metal Grinding, Machine Shopping, Polishing and Buffing, Sandblasting, Pickling, Acid Dipping, Electroplating, Tinning, Wood-working, Painting and Varnishing, Enameling, Etching.

DRY CLEANING AND DYEING.

This non-manufacturing industry is not, of course, included in the Census reports. Our investigations covered 27 establishments, in 6 cities, employing a total of 698 wage-earners, of whom 263 were males and 435 were females. The chief processes of health-hazardous character were found to be: Dry (and Steam) Cleaning, Dyeing, Ironing and Pressing, and Carpet Cleaning. In addition, one establishment was engaged in laundry processes and another in the manufacture of rugs.

ELECTRICAL MACHINERY, APPARATUS AND SUPPLIES.

The Census gives 115 establishments, employing 8,073 wage-earners, or 1.8% of the total wage-earners in the state. Our investigations covered 29 establishments, in 11 cities, employing a total of 8,982 wage-earners, of whom 6,576 were males and 2,368 were females. The chief processes of health-hazardous character were found to be: Brass Founding, Iron Founding, Core Making, Forging and Blacksmithing, Metal Grinding, Polishing and Buffing, Machine Shopping, Soldering, Tempering, Pickling, Acid Dipping, Electroplating, Sandblasting, Furnacing, Storage Battery Manufacturing, Dry Battery Manufacturing, Wood-working, Mixing Chemicals, Shellacing and Lacquering, Painting and Varnishing, Incandescent Lamp Manufacturing, Pottery Processes.

ELECTROPLATING.

The Census gives 29 establishments engaged in this industry, employing a total of 205 wage-earners. Our investigations covered 8 establishments, in 5 cities, employing a total of 110 wage-earners, all males. In addition, electroplating processes have been considered elsewhere in connection with a great many lines of industry. The chief

processes of health-hazardous character are: Metal Grinding, Polishing and Buffing, Acid Dipping, Electroplating, Shellacing and Lacquering.

ENAMELING AND JAPANNING.

The Census gives 5 establishments in this industry, employing a total of 145 wage-earners. Our investigations covered 5 establishments, in 3 cities, employing a total of 115 employes, of whom 102 were males and 13 were females. The chief processes of health-hazardous character were found to be: Furnacing, Machine Shopping, Acid Dipping, Pickling, Mixing Chemicals, Sandblasting, Enameling, Painting and Varnishing, Japanning.

ENGRAVING AND DYE-SINKING.

The Census gives 8 firms engaged in this process, but the number of wage-earners is not stated. However, engraving is a process associated with a number of industries and figures cannot be considered at all representative. Our investigations covered 5 establishments, in 3 cities, employing a total of 105 wage-earners, 95 of whom were males and 10 were females. The chief processes of health-hazardous character were found to be: Engraving, Chemical Processes (Photography), and sedentary work in the nature of Designing and Illustrating. (See also Photo-Engraving.)

EXPLOSIVES.

The Census gives 11 establishments in this industry, employing 358 wage-earners, or 0.1% of the total wage-earners in the state. Our investigations covered 7 plants, in 7 city vicinities, employing a total of 994 workers, of whom 755 were males and 239 were females. (These figures include one large ammunition factory, the majority of whose employes were not concerned with explosives directly.) The chief processes of health-hazardous character were found to be: the Manufacture of Explosives, in addition to which were Founding (see Brass), Machine Shopping, Soldering, Wood-working, and Painting and Varnishing.

FERTILIZERS.

The Census gives 27 establishments in this industry, employing 841 wage-earners, or 0.2% of the total wage-earners in the state. Our investigations covered 10 establishments, in 4 cities, employing 849 wage-earners, of whom 839 were males and 10 were females. The chief health-hazards were found to be: Fertilizer Manufacturing, Oil Refining, Glue Making.

FILES.

The Census shows 7 establishments engaged in this industry, employing 139 wage-earners. Our investigation covered 4 establishments, in 3 cities, employing 108 wage-earners, all males. The chief processes of health-hazardous character were found to be: Tempering, File Cutting, Metal Grinding, Machine Shopping.

FLAVORING EXTRACTS.

The Census gives 37 establishments in this industry. The total number of employes is too small to be mentioned. Our investigations covered 2 establishments, in 1 city, employing a total of 18 wage-earners, of whom 16 were males and 2 were females. The chief health-hazard is Mixing Chemicals.

FOUNDRY AND MACHINE SHOP PRODUCTS.

This industry, which is the first in importance in the state, comprises, according to the Census, 1,218 establishments, employing a total of 64,817 wage-earners, or 14.5% of the total wage-earners in the state. Our investigations covered 47 establishments, in 11 cities, employing a total of 14,484 wage-earners, of whom 13,857 were males and 627 were females. The chief processes of health-hazardous character were found to be: Iron Founding, Brass Founding, Core Making, Forging and Blacksmithing, Tempering, Welding, Metal Grinding, Machine Shopping, Furnacing, Pickling, Tinning, Galvanizing, Soldering, Brazing, Hot Riveting, Mixing Chemicals, Acid Dipping, Electroplating, Babbitting, Polishing and Buffing, Sandblasting, Tumbling, Oil Refining, Wood-working, Painting and Varnishing, Shellacing and Lacquering, Staining, Enameling, Japanning.

According to the Vital Statistics Reports for the State of Ohio, for the years 1910, 1911 and 1912, there were reported the deaths of 605 molders, of whom 110 died of pulmonary tuberculosis, or 18.18% of their deaths. During the same period there were reported the deaths of 1,195 machinists, of whom 224 died of pulmonary tuberculosis, or 18.74% of their deaths. These rates are to be compared to the pulmonary tuberculosis death rate of all occupations in the state combined for the same years, which was 13.3%; and are also to be compared to the pulmonary tuberculosis death rate of those engaged in Agricultural Pursuits during the same period, which was 7.13%.

FUR GOODS.

The Census gives 18 establishments, employing 167 wage-earners. Our investigations covered 4 establishments, in 3 cities, employing a total of 44 wage-earners, of whom 21 were males and 23 were females. No curing of furs was done. The chief health-hazards were found to be: Sewing, and the use of hard-wood dust (oak and mahogany) and corn meal flour to clean the furs. One case of chronic conjunctivitis and blepharitis was reported, due, probably to the effects of this dust. Also it was found that yellow furs were dyed yellow with anilin dyes, used dry. No workers were at the time so employed. Whether this yellow dye is poisonous or not we are unable to state, although saffron yellow and anilin orange are regarded as suspicious or injurious to health. Furs collected in Ohio are "fleshed" and then sent elsewhere for tanning and curing, then returned and made up here. The fur animals of the state are mink, muskrat, skunk, ferret, raccoon, fox and squirrel.

FURNITURE AND REFRIGERATORS.

The Census gives 228 establishments engaged in this industry, employing a total of 8,232 wage-earners, or 1.8% of the total wage-earners in the state. Our investigations covered 19 establishments, in 8 cities, employing a total of 3,953 wage-earners, of whom 3,837 were males and 116 were females. The chief processes of health-hazardous character were found to be: Machine Shopping, Wood-working, Acid Dipping, Electroplating, Brazing, Painting and Varnishing, Shellacing and Lacquering, Staining, Enameling, Gluing, Tinning, Upholstering. (See Wood-working for Vital Statistics.)

GAS, ILLUMINATING AND HEATING.

The Census gives 38 establishments engaged in this process, employing 666 wage-earners, or about 0.2% of the total wage-earners in the state. Our investigations of this industry covered but 2 independent concerns, employing a total of 55 wage-earners, all males, but in connection with a number of establishments the gas-producing plant was investigated. The chief health-hazards of this industry are given under Gas Producing.

GALVANIZING.

The Census gives 5 establishments, but the number of wage-earners is not stated. Our investigations covered 2 establishments, engaged solely in galvanizing, in 2 cities, employing a total of 33 males.

However, the great bulk of galvanized goods are made in Iron and Steel Rolling Mills, where it is reported upon elsewhere. The chief processes of health-hazardous character were found to be: Pickling and Galvanizing.

GLASS.—CUTTING, STAINING AND ORNAMENTING.

(Glass manufacturing is considered elsewhere.)

The Census gives 34 establishments engaged in this industry, but the number of employes is not stated. Our investigations covered 10 establishments, in 4 cities, employing a total of 347 wage-earners, of whom 329 were males and 18 were females. The chief processes of health-hazardous character were found to be: Glass Finishing, Glass Etching, Mirror Making, Sandblasting, Soldering, Electroplating, Painting and Gilding. There is also Transfer Work (Decalcomania), and some Glass Blowing, but only a few so employed.

HATS, FUR-FELT.

The Census gives 3 establishments engaged in this industry, employing a total of 9 wage-earners. Our investigations covered 2 establishments, employing a total of 166 wage-earners, of whom 64 were males and 102 were females. The health-hazardous processes were found to be: Dyeing, Ironing and Pressing, Sewing, Shellacing and Varnishing, also Founding. In addition, the process of Steaming, to shape the hats over molds, was found to be a work largely done by foreigners, who barely understood English, although a fair amount of skill was necessary. There was considerable exposure to humidity, due to steam and vapors of undetermined character, windows being the only method of ventilation. Work was rather warm. Fatigue was more than a moderate hazard, due to piece-work, monotony, constant standing, body pressure, eye-strain and noise. A 9-hour day, with 1 hour off for noon was the rule. The men ate in the workrooms, and there was no medical supervision.

INSTRUMENTS; PROFESSIONAL, SCIENTIFIC.

The Census gives 17 establishments engaged in this industry, but the number of wage-earners is not stated. Our investigations covered 2 establishments, in 2 cities, employing a total of 175 wage-earners, of whom 120 were males and 55 were females. The chief processes of health-hazardous character were found to be: Machine Shopping, Soldering, Welding, Polishing and Buffing, Electroplating, Glass Finishing.

IRON AND STEEL DOORS AND SHUTTERS.

The Census gives 3 establishments, without stating the number of wage-earners. Our investigations covered 1 establishment, in 1 city, employing 90 wage-earners, all males. The chief processes of health-hazardous character were found to be: Machine Shopping and Painting.

JEWELRY.

The Census gives 35 establishments, employing a total of 356 wage-earners. Our investigations covered 3 establishments, in 1 city, employing a total of 23 wage-earners, all males. Apparently there is no diamond cutting as a regular process done in this state, hence the dangers of lead poisoning and dust from this source may be considered almost nil. One health-hazardous process is Soldering, in which the worker has his face very close to the fumes which arise, and another is the inhalation of metallic dusts from Polishing and Buffing. At two of the places inspected good exhaust systems were present. Another hazard is fatigue, due to eye-strain, monotony, faulty postures, blow-piping, etc. There is also Engraving, Etching and Electroplating. There is some risk from lead fumes, cyanid fumes from hot baths, mercury vapor and acid fumes, as well as shellacs, which are used. No cases of eczema or skin trouble were found.

JUNK.

(Sorting Rags and Scrap Metals.)

The Census gives no figures for this non-manufacturing industry. Our investigations covered 22 establishments, in 4 cities, employing a total of 406 wage-earners, of whom 334 were males and 72 were females. These figures do not include those engaged in sorting and handling of rags in paper-stock companies. The chief health-hazardous processes were found to be: Junk Sorting, and occasionally melting down of non-ferrous metals. (See Brass Foundry; also Paper Manufacturing.)

LEAD.—BAR, PIPE AND SHEET.

The Census gives 2 establishments engaged in this industry, but the number of wage-earners is not stated. Our investigations covered 3 establishments, in 2 cities, employing a total of 34 wage-earners, all males. This does not include establishments considered as lead oxide manufacturing (see Paint Manufacturing). The chief health-hazard is the handling, melting and pouring of lead—in other words, Founding. (See Foundry, Brass.) In one plant efficient hoods and venti-

lating stacks were provided. In the other 2 these were absent. There was a general ignorance of personal hygiene respecting lead poisoning, and the workers were allowed to eat anywhere. Washing facilities were very inadequate. One lead poisoned worker was seen in one of the places.

LEATHER.—TANNED, CURED AND FINISHED.

The Census gives 36 establishments, employing 1,884 wage-earners, or 0.4% of the total wage-earners in the state. Our investigations covered 8 establishments, in 4 cities, employing 1,120 wage-earners, all males. The chief processes of health-hazardous character were found to be: Leather Handling, Leather Dyeing and Leather Chemical Processes.

LIME.

The Census gives 39 establishments engaged in this industry, employing a total of 1,273 wage-earners, or about 0.3% of the total wage-earners in the state. Our investigations covered 7 establishments, in 6 cities, employing 556 wage-earners.

The process is considered under the head of Lime Burning. There is also Quarrying and Gas Producing.

MATCHES.

The Census gives 4 establishments engaged in this industry, but does not state the number of wage-earners. Our investigations covered 3 establishments, in 3 cities, employing a total of 1,782 wage-earners, of whom 1,313 were males and 469 were females. The chief processes of health-hazardous character are given under Matches (Part V.) (Most of the workers are in General Factory Processes.)

MIRRORS.

The Census gives 8 establishments, employing 94 wage-earners. Our investigations covered 5 establishments, in 3 cities, employing a total of 89 wage-earners, all males (these are in addition to Mirror Making done by firms in the art glass business). The chief processes of health-hazardous character were found to be: Mirror Making (Silvering), Glass Finishing, and Polishing and Buffing.

MUSICAL INSTRUMENTS, PIANOS, ORGANS AND MATERIALS.

The Census gives 30 establishments engaged in this industry, employing 1,841 wage-earners, or 0.4% of the total wage-earners in the state. Our investigations covered 5 establishments, in 3 cities, employing a total of 851 wage-earners, of whom 4 were females. The chief

processes of health-hazardous character were: Brass Founding, Iron Founding, Core Making, Metal Grinding, Tumbling, Polishing and Buffing, Furnacing, Machine Shopping, Soldering (also Welding, Brazing), Acid Dipping, Electroplating, Wood-working, Gluing, Painting and Varnishing, Shellacing and Lacquering, Japanning and Bronzing.

OILCLOTH AND LINOLEUM.

The Census gives 3 establishments, but the number of wage-earners is not stated. Our investigations covered 3 establishments, in 3 cities, employing a total of 240 wage-earners, all males. The chief processes of health-hazardous character were found to be: Oil Cloth and Linoleum Manufacturing, Oil Refining, Printing and Dyeing.

OIL (LINSEED) AND PETROLEUM REFINING.

The Census gives 14 establishments, employing 1,872 wage-earners, or about 0.5% of the total wage-earners in the state. Our investigations covered 5 establishments, in 3 cities, employing 1,007 wage-earners, all males. The chief processes of health-hazardous character were found to be: Oil Refining, Lead Burning (Soldering), Machine Shopping and Wood-working.

PAINT AND VARNISH.

The Census gives 87 establishments, employing 1,535 wage-earners, or 0.3% of the total wage-earners in the state. Our investigations covered 40 establishments, in 6 cities, employing a total of 2,379 wage-earners, of whom 2,041 were males and 338 were females. The chief processes of health-hazardous character were found to be: Manufacturing Lead Compounds, Paint and Varnish, Filling Paint and Varnish Containers, and Labeling; also Founding (See Brass), manufacturing Tin Cans and Soldering.

PATENT MEDICINES AND COMPOUNDS, AND DRUGGISTS' PREPARATIONS.

The Census gives 261 establishments engaged in this industry, employing 905 wage-earners, or 0.2% of the total wage-earners in the state. It will be observed that the average number of wage-earners per each establishment is very low. Our investigations covered 1 establishment, employing 95 wage-earners, of whom 47 were males and 48 were females. Health-hazards in this industry are chiefly those of Factory Processes in General. See also Mixing Chemicals.

PHOTO-ENGRAVING.

The Census gives 20 establishments, employing 277 wage-earners. Our investigations covered 2 establishments, in 4 cities, employing 36 wage-earners, all males, in addition to those in conjunction with printing and publishing establishments. The principal health-hazards were found to be: Art and Designing, Photography, Copper and Zinc Printing and Etching, and Blocking. (Photo-engraving has been considered under Printing—Art, Half-tone, Etching, etc.)

PORCELAIN ENAMELED IRON WARE.

The Census does not give this industry by itself; but probably includes it in Foundry and Machine Shop Products. Our investigations covered 5 establishments, in 3 cities, employing a total of 504 wage-earners, all males. The chief processes of health-hazardous character were found to be: Porcelain Enameling of Iron Ware, Brass Founding, Iron Founding, Core Making, Machine Shopping, Metal Grinding, Sandblasting, Wood-working, Painting and Varnishing.

POTTERY, TERRA COTTA AND FIRE CLAY PRODUCTS.

The Census gives 186 establishments, employing 16,519 wage-earners, or 3.7% of the total wage-earners in the state. Our investigations covered 56 establishments, in 16 cities, employing a total of 9,494 wage-earners, of whom 6,800 were males, and 2,694 were females. The branches of the industry investigated were:

		No. of Potteries.
(1)	White, China and Sanitary Ware	34
(2)	Yellow, Art and Utility Ware	8
(3)	Stoneware	8
(4)	Tiles (decorative)	4
(5)	Porcelain (electrical)	2
	Total	56

The principal processes of health-hazardous character in this industry were found to be: Slip Making, Glaze Making, Sagger Making, Mold Making, Clay-room Processes, Glaze Dipping, Biscuit and Glost Kilning, Biscuit and Glost Finishing, Decorating, Assorting (Shading), and Packing and Shipping.

According to the State Vital Statistics Reports, there were 225 deaths among male Potters in the state during the years 1910, 1911 and 1912, of whom 53, or 23.6% died of pulmonary tuberculosis. The

rates for females in this industry are not given. It must also be borne in mind that this rate is conservative, since a certain percentage of consumptive potters leave the state and die elsewhere, or leave the industry and take up other callings before death ensues. This rate is to be compared to the pulmonary tuberculosis death rate of all occupations in the state combined, for the same years, which was 13.3%; and is also to be compared to the pulmonary tuberculosis death rate of those engaged in Agricultural Pursuits during the same period, which was 7.13%.

PRINTING AND PUBLISHING.

The Census gives 1,655 establishments, employing 15,756 wage-earners, or 3.5% of the total wage-earners in the state. Our investigations covered 34 establishments, in 5 cities, employing a total of 2,725 wage-earners, of whom 2,325 were males and 390 were females. The principal processes of health-hazardous character were found to be: Composition and Miscellaneous Small Work, Type-Machine Processes, Printing Press Processes, Bookbinding, Artistic Work, Half-tones, Etchings, etc., Lithographing, Compounding Chemicals, Gluing, Founding (Brass). No type-founding of consequence appears to be done in the State of Ohio.

According to the Vital Statistics Reports for the State of Ohio, for the years 1910, 1911 and 1912, there were a total of 273 deaths reported among Printers, Pressmen and Compositors, of whom 58 died of pulmonary tuberculosis, or 21.25%. This rate is to be compared to the pulmonary tuberculosis death rate of all occupations in the state combined, for the same years, which was 13.3%; and is also to be compared to the pulmonary tuberculosis death rate of those engaged in Agricultural Pursuits during the same period, which was 7.13%.

ROOFING MATERIALS.

The Census gives 11 establishments, but the number of wage-earners is not stated. Our investigators covered 3 establishments, in 3 cities, employing a total of 141 wage-earners, of whom 135 were males and 6 were females. The roofing materials in question consisted of the various types of roofing paper. The chief processes of health-hazardous character were found to be: Rag-Sorting and Handling, Paper Manufacturing, Machine Shopping, and Mixing Chemicals.

RUBBER GOODS.

(Not elsewhere specified.)

The Census gives 37 establishments, employing 10,382 wage-earners, or 2.4% of the total wage-earners in the state. Our investiga-

tions covered 32 establishments, in 14 cities, employing a total of 25,060 wage-earners, of whom 22,173 were males and 2,887 were females. Two or three of the large companies had sick benefit associations among the employes, but only a portion of the latter were members. There were no unions. The attitude toward employes was usually very good, while all the larger companies maintained welfare and efficiency departments. No organized instructions along health lines were given to employes, nor were placards, other than "Don't Spit" signs, observed. The chief poisons used in the industry were in the order of their danger to users: Anilin oil, carbon bisulphide, benzol (benzene), lead compounds, antimony compounds, mineral acids, alkalis, benzine (naphtha, petrol, gasoline), wood alcohol, sulphur chloride, carbon tetrachloride, mercuric sulphide, and turpentine; in some processes there were also the risks of leaks from illuminating and fuel gas. A considerable part of the work was done on the two or three shift plan extending over the 24 hours. The chief processes of health-hazardous character were found to be: Rubber Washing, Compounding, Mixing Mills, Calendering (including Warming Mills), Tire Building, Pit Curing, Hot-Press Curing, Dipping, Cold Curing, Vapor Curing, Making Inner Tubes, Buffing, Reclaiming, Cement Mixing, Specialty Manufacturing. In addition, there were the following processes of health-hazardous character: Forging and Blacksmithing, Machine Shopping, Wood-working, and Mixing Chemicals, while the vast lot of workers were engaged in General Factory Processes.

According to the Vital Statistics Reports for the State of Ohio, for the years 1910, 1911 and 1912, there were 118 deaths among Rubber Factory Operatives (males), of whom 23 died of pulmonary tuberculosis, or 19.49% of their deaths. This rate is to be compared to the pulmonary tuberculosis death rate of all occupations in the state combined, for the same years, which was 13.3%; and is also to be compared to the pulmonary tuberculosis death rate of those engaged in Agricultural Pursuits during the same period, which was 7.13%. (See also Special Health Report of a Rubber Company, Part IV.)

SAFES AND VAULTS.

The Census gives 10 establishments, employing 2,014 wage-earners, or 0.5% of the total wage-earners in the state. Our investigations covered 4 establishments, in 3 cities, employing a total of 1,074 wage-earners, all males. In one other plant the painting department alone was visited, employing 68 men at this work. This does not include establishments investigated, which were also engaged in the manufacture of stoves. The chief health-hazards of this industry were

found to be: Iron Founding, Metal Grinding, Machine Shopping, Polishing and Buffing, Welding, Electroplating, Sandblasting, Painting and Varnishing, and Enameling.

SALT.

The Census gives 8 establishments engaged in this industry, employing a total of 648 wage-earners. Our investigations covered 1 establishment, in 1 city, employing 150 wage-earners, of whom 135 were males and 15 were females. The chief processes of health-hazardous character were found to be: Salt Manufacturing and Cooperage (Wood-working).

SCALES AND BALANCES.

The Census gives 6 establishments engaged in this industry, but does not state the number of wage-earners. Our investigations covered 3 establishments, in 3 cities, employing a total of 700 wage-earners, of whom 650 were males and 50 were females. The chief processes of health-hazardous character were found to be: Forging and Blacksmithing, Metal Grinding, Polishing and Buffing, Machine Shopping, Tempering, Acid Dipping, Electroplating, Wood-working, Painting and Varnishing, Shellacing and Lacquering.

SHIPBUILDING, INCLUDING BOAT BUILDING.

The Census gives 39 establishments engaged in this industry, employing a total of 3,200 wage-earners, or 0.8% of the total wage-earners in the state. Our investigations covered 3 establishments, in 2 cities, employing a total of 1,480 wage-earners, all males. The chief processes of health-hazardous character in this industry were found to be: Iron Founding, Forging and Blacksmithing, Machine Shopping, Soldering, Wood-working, Painting and Varnishing (Caulking), Shellacing.

SIGNS AND ADVERTISING NOVELTIES.

The Census gives 28 establishments engaged in this industry, employing 1,096 wage-earners, or 0.2% of the total wage-earners in the state. Our investigations covered 12 establishments, in 4 cities, employing a total of 1,043 wage-earners, of whom 790 were males and 253 were females. The chief processes of health-hazardous character were found to be: Machine Shopping, Soldering, Furnacing (Kilning), Acid Dipping, Electroplating, Mixing Chemicals, Printing Processes, Lithographing, Artist's Work, Painting and Varnishing, Enameling, Paint Mixing, Bronzing, Wood-working, and Factory Processes such as Leather Skiving, Celluloid Finishing, Assembling, etc.

SMELTING AND REFINING.

(Not from the Ore.)

The Census gives 6 establishments, employing 57 wage-earners. Our investigations covered 4 establishments, in 2 cities, employing 45 wage-earners, all males. The chief processes of health-hazardous character were found to be: Junk Sorting and Handling, Soft Metal Melting (see Founding, Brass).

SPRINGS.—STEEL CAR AND CARRIAGE.

The Census gives 5 establishments engaged in this industry, but does not state the number of wage-earners. Our investigations covered 6 establishments, in 4 cities, employing a total of 653 wage-earners, all males. The chief processes of health-hazardous character were found to be: Furnacing, Hot Rolling, Forging and Blacksmithing. Machine Shopping, Metal Grinding, Tempering, Electroplating, and Tool Making (see Cutlery and Tools).

STEREOTYPING AND ELECTROTYPING.

The Census gives 14 establishments engaged in this industry, employing a total of 207 wage-earners. Our investigations covered 6 establishments, in 3 cities, employing a total of 229 wage-earners, all males. The processes were also investigated in several printing establishments (see the various Printing Processes, especially Type Machine Work). The chief processes of health-hazardous character were found to be: Founding (Brass), Mixing Chemicals, and Electroplating. Some of these establishments were also engaged in the Printing Processes.

STOVES AND FURNACES.

The Census gives 102 establishments engaged in this industry, employing a total of 7,274 wage-earners, or 1.6% of the total wage-earners in the state. Our investigations covered 15 establishments, in 9 cities, engaged mostly in the manufacture of stoves rather than furnaces. The manufacture of safes was found to be an auxiliary feature with some of these companies. The total wage-earners in the plants covered by our investigations were 5,160, of whom 5,104 were males and 56 were females. The chief processes of health-hazardous character were found to be: Iron Founding, Core Making, Metal Grinding, Sandblasting, Tumbling, Polishing and Buffing, Machine Shopping, Welding, Soldering, Acid Dipping, Pickling, Electroplating, Enameling, Japanning, Painting and Varnishing, Wood-working.

TIN PLATE AND TERNE PLATE.

The Census gives 4 establishments engaged in this industry, employing a total of 676 wage-earners, or 0.2% of the total wage-earners in the state. Our investigations covered 5 establishments, in 5 cities, employing a total of 2,989 wage-earners, but of these only 616 were engaged in the tin and terne plate processes, including 74 females. (The balance are considered under Iron and Steel Rolling Mills.) The chief processes of health-hazardous character were found to be: Pickling, Tinning, Machine Shopping, Forging and Blacksmithing, and Lacquering.

TOYS AND GAMES.

The Census gives 19 establishments engaged in this industry, but does not state the number of wage-earners. Our investigations covered 4 establishments, in 2 cities, employing a total of 625 wage-earners, of whom 569 were males and 56 were females. The chief processes of health-hazardous character were found to be: Metal Grinding, Machine Shopping, Welding, Tinning, Electroplating, Brazing, Enameling, Painting and Varnishing, Upholstering.

INDUSTRIES HAVING A KNOWN ASSOCIATION WITH DUST.

Comment.—The chief health-hazard of the industries considered here is DUST. This does not imply that dust is not also a chief health-hazard in industries considered elsewhere, nor that dust is the only health-hazard of concern here.

BRICK AND TILE.

The Census gives 517 establishments engaged in this industry, employing a total of 7,466 wage-earners, or 1.7% of the total wage-earners in the state. Our investigations covered 9 establishments, in 7 cities, employing a total of 716 wage-earners, all males. The chief processes of health-hazardous character were found to be: (Brick) Clay Mixing and Grinding, Pressing and Kilning.

BROOMS.

The Census gives 82 establishments engaged in making brooms, employing a total of 393 wage-earners. Our investigations covered 10 establishments, in 2 cities, employing a total of 86 wage-earners, of whom 82 were males and 4 were females. The hazards of the process are stated under Broom Manufacture.

CEMENT.

The Census gives 9 establishments engaged in cement making, employing 887 wage-earners, or 0.2% of the total wage-earners in tthe state. Our investigators covered 2 establishments, in 2 cities, employing 162 wage-earners, all males. The hazards are considered under the heading "Cement Making."

COOPERAGE AND WOODEN GOODS.

(Not specified elsewhere.)

Under this heading the Census gives 113 establishments, employing a total of 1,663 wage-earners, or 0.4% of the total wage-earners in the state. Our investigations covered 1 establishment, employing 390 wage-earners, all males. The chief processes of health-hazardous character were found to be: Wood-working; also Forging and Blacksmithing, Machine Shopping, Metal Grinding, Sandblasting, and Painting. In addition to the above figures, our investigations covered this industry in a large number of establishments where it was auxiliary to their principal processes. As noted from the processes named, there is nothing hygienically peculiar to the industry as such.

CORDAGE, TWINE, JUTE AND LINEN GOODS.

The Census give 8 establishments engaged in this industry, employing a total of 791 wage-earners, or 0.2% of the total wage-earners in the state. Our investigations covered 5 establishments, in 3 cities. employing a total of 510 wage-earners, of whom 434 were males and 76 were females. The chief processes of health-hazardous character are considered under the head of Cordage Making (Breaking, Spreading, Drawing, etc.), Spinning, Rope and Twine Making, and Finishing.

EMERY AND OTHER ABRASIVE WHEELS.

The Census gives 3 establishments engaged in this industry, but does not state the number of wage-earners. Our investigations covered 2 establishments, in 2 cities, employing a total of 112 wage-earners, all males. The chief processes of health-hazardous character were found to be: Emery Mixing, Emery Wheel Truing, Furnacing. Babbitting.

FLOUR AND GRIST MILL PRODUCTS.

The Census gives 673 establishments engaged in this industry, employing a total of 2,585 wage-earners, or 0.6% of the total wage-

earners in the state. Our investigations covered but 2 establishments, employing a total of 85 wage-earners, all males. As flour itself is practically a harmless dust, and occupational complaints are very rarely reported from this type of industry, we did not take time to investigate this line further. Cooperage is an auxiliary process, and is considered elsewhere. The manufacture of cereal products is not considered here.

GRINDSTONE.

The Census gives 9 establishments engaged in this industry, employing 1,277 wage-earners, or 0.3% of the total wage-earners in the state. Our investigations covered this process in 4 establishments, in 3 cities, employing 878 at this process. The balance of the workers are considered under Marble and Stone Workers.

MARBLE AND STONE.

The Census gives 198 establishments engaged in this industry, employing a total of 2,012 wage-earners, or 0.5% of the total wage-earners in the state. Our investigations were directed principally to the Sawing and Finishing of Stone, Monuments, and Grindstones, rather than to Quarrying, and covered 19 establishments, in 5 cities and vicinities, employing a total of 705 wage-earners, all males. The chief processes of health-hazardous character were found to be: Surfacing, including Designing and Polishing, Sawing, Cutting, Machine Shopping, Forging and Blacksmithing, and the Making of Grindstones.

According to the Ohio Vital Statistics Reports, there were, for the years 1910, 1911 and 1912, 163 deaths reported among Marble and Stone Cutters, of which number 45 deaths were due to pulmonary tuberculosis, or 27.61% of their total deaths. This rate is to be compared to the pulmonary tuberculosis death rate of all occupations in the State combined, for the same years, which was 13.3%; and is also to be compared to the pulmonary tuberculosis death rate of those engaged in Agricultural Pursuits during the same period, which was 7.13%.

MATTRESSES AND BED SPRINGS.

The Census gives 38 establishments engaged in this industry, employing 961 wage-earners, or 0.2% of the total wage-earners in the state. Our investigations covered 6 establishments, in 5 cities, employing a total of 205 wage-earners, of whom 152 were males, and 53 were females. The chief processes of health-hazarodus character are given under Mattresses and Feathers, Sewing and Finishing.

PAPER AND WOOD PULP.

The Census gives 47 establishments engaged in this industry, employing 4,673 wage-earners, or 1.0% of the total wage-earners in the state. Our investigations covered 13 establishments (exclusive of Roofing Materials), in 7 cities, employing a total of 2,967 wage-earners, of whom 2,304 were males and 663 were females. The chief processes of health-hazardous character were found to be: Rag Sorting, Paper Beating, Paper Machining, Printing, Forging and Blacksmithing, Mixing Chemicals, Sewing, Engraving, Gluing and Pasting.

WOOD, TURNED AND CARVED.

The Census gives 83 establishments engaged in this industry, but does not state the number of wage-earners. Our investigations covered 2 establishments, in 1 city, employing a total of 85 wage-earners, of whom 81 were males and 4 were females. (See also Furniture and Refrigerators.) The chief processes of health-hazardous character were found to be: Wood-working, Shellacing and Lacquering, Staining, and Factory Processes.

INDUSTRIES IN WHICH FATIGUE, MONOTONY OR INACTIVITY ARE PRINCIPAL HEALTH-HAZARDS.

BOOTS AND SHOES.

The Census gives 72 establishments engaged in this industry, employing a total of 16,026 wage-earners, or 3.6% of the total wage-earners in the state. This is the fifth industry in importance in the number of wage-earners employed in the State. Our investigations covered 29 establishments, in 9 cities, employing a total of 11,806 wage-earners, of whom 6,727 were males and 5,079 were females. The chief processes of health-hazardous character were found to be: Leather Cutting, Fitting, Lasting, Finishing and Packing.

According to the Ohio Vital Statistics Reports, there were 121 deaths reported during the years 1910, 1911 and 1912, among male Boot and Shoe Factory Operatives, of which 31 were due to pulmonary tuberculosis, or 25.62% of their deaths. According to the same Reports, there were only 31 deaths reported among female Boot and Shoe Factory Operatives, but of these 18 were due to pulmonary tuberculosis, or 58.06% of their deaths. The numbers of deaths are too small to be given much significance. These rates may be compared to the pulmonary tuberculosis death rate of all occupations in the State combined, for the same years, which was 13.3%; and also may be compared

to the pulmonary tuberculosis death rate of those engaged in Agricultural Pursuits during the same period, which was 7.13%.

The following paragraph is taken from the Cincinnati Tuberculosis Hospital Report for the year 1912:

"Twenty-seven shoemakers were admitted. This occupation seems to be especially dangerous. Ninety-five per cent of the Union Shoemakers who died in Cincinnati in 1912 died of tuberculosis. These men work at benches in teams of five, the unfinished product being passed to the next man and so on. Each man occupies about two and one-half feet of the bench. Any infected case, talking or coughing, ejects a spray of saliva which is inhaled by his neighbor. This man is known as a tuberculosis carrier."

CLOTHING AND TEXTILE MANUFACTURING.

(Including Cotton and Woolen Goods.)

While Men's and Women's Clothing are separately considered in the Census, there is no sufficient reason for considering them separately in this report. According to the Census, the combined industries represent 495 establishments, with a total of 18,793 wage-earners, making it the fourth in importance in the number of wage-earners in the state. It employes 4.2% of the total wage-earners. If the Cotton Goods, including 4 establishments with 177 wage-earners, and the Woolen Goods, including 20 establishments with 2,566 wage-earners, are added, the Cothing and Textile Manufacturing Industry becomes the third in point of wage-earners in the State. Our investigations covered only a very small part of this field, but we have endeavored to spread out the inquiry into enough branches of the industry to give the chief hygienic facts. Our investigations covered 17 establishments, in 6 cities, employing a total of 7,158, of whom 2,277 were males and 4,881 were females. The smallest place seen employed 32 workers, the largest, 1900. The chief processes of health-hazardous character are conveniently grouped as follows: Wool Sorting, Washing (including scouring, drying, shrinking), Carding (with combing, warping, twisting, winding and spinning; napping and fleecing), Weaving and Knitting, Sewing, Ironing and Pressing, Cutting Cloth, and General Factory Processes, such as cleaning, finishing, burling, mending, splicing, inspecting, packing, boxing, etc. Designing is about the same as elsewhere described.

According to the Ohio Vital Statistics Reports, there were in the years 1910, 1911 and 1912, 522 deaths reported among male tailors, of which 90 were due to pulmonary tuberculosis, or 17.25% of their deaths. According to the same Reports, there were 610 deaths among

females (tailoresses, dressmakers and seamstresses), 138 of which were due to pulmonary tuberculosis, or 22.62% of their deaths. There were, in addition, some deaths from tuberculosis of other parts than the lungs, making the total tuberculosis death rate still higher. These rates are to be compared to the pulmonary tuberculosis death rate of all occupations in the State combined, for the same years, which was 13.3%; and are also to be compared to the pulmonary tuberculosis death rate of those engaged in Agricultural Pursuits during the same period, which was 7.13%.

FLAGS, BANNERS, REGALIA, BADGES AND EMBLEMS.

The Census gives 13 establishments engaged in this industry, employing a total of 1,262 wage-earners, or 0.3% of the total wage-earners in the state. Our investigations covered 2 establishments, in 2 cities, employing a total of 949 wage-earners, of whom 340 were males and 609 were females. The chief processes of health-hazardous character were found to be: Sewing, Ironing and Pressing, Cutting Cloth, Brass Founding, Electroplating, Polishing and Buffing, Shellacing and Lacquering, Painting and Varnishing, Bronzing, Artist's Work (see Printing), Wood-working, Gluing and Pasting. Our attention was drawn to some sickness complaints among one or two felt hat workers, but an industrial relationship could not be established. Investigations showed that they were slightly exposed to ammonia, but not to mercury, as was feared.

IRON AND STEEL BOLTS, NUTS, WASHERS AND RIVETS.

(Not Made in Steel Works or Rolling Mills.)

The Census gives 17 establishments engaged in this industry, but does not state the number of wage-earners. Our investigations covered 4 establishments, in 2 cities, employing a total of 1,584 wage-earners, of whom 1,090 were males and 494 were females. The chief processes of health-hazardous character were found to be: Forging and Blacksmithing, Tempering, Galvanizing, Electroplating, Furnacing, Machine Shopping and Wire Manufacture.

TOBACCO MANUFACTURE.

The Census gives 1,146 establishments engaged in this industry, employing a total of 12,631 wage-earners, or 2.8% of the total wage-earners in the state. This appears to be the eight industry in point of wage-earners in the state. Our investigations covered 27 establishments, in 13 cities, employing a total of 6,254, of whom 1,791 were

males and 4,463 were females. This industry is one of the largest female-employing in the state. The chief processes of health-hazardour character were found to be: Tobacco Moistening, Stemming, Rolling, and Miscellaneous Processes.

According to the Vital Statistics Reports there were, for the years 1910, 1911 and 1912, 261 deaths among male Tobacco and Cigar Factory Operatives, of whom 50 died of pulmonary tuberculosis, or 19.15% of their deaths. The industrial reports for females were too incomplete to be taken as representative, but of 36 authentic deaths reported, 16 were due to tuberculosis, or 44.44%. The Mortality Statistics of the U. S. Census for the Registration Area in 1909 gives the pulmonary tuberculosis death rates for male Tobacco and Cigar Factory Operatives as 24.3%, and for females as 40.5%.

INDUSTRIES IN WHICH HEAT, COLD, MOISTURE AND DAMPNESS ARE THE CHIEF HEALTH-HAZARDS.

BAKERIES.

The Census gives no statistics concerning this industry. Our investigations covered 8 establishments, in 3 cities, employing a total of 974 wage-earners, of whom 653 were males and 141 were females. The chief processes of health-hazardous character are considered under the head of Baking Processes. A large number of the workers are engaged in what may be considered ordinary Factory Processes.

CANNING AND PRESERVING.

The Census gives 107 establishments engaged in this industry, employing a total of 2,009 wage-earners, or 0.4% of the total wage-earners in the state. However, these are pre-eminently short-season workers. Our investigations covered 13 establishments, in 11 cities, employing a total of 1,346 wage-earners, of whom 685 were males and 661 were females. The chief processes of health-hazardous character were found to be: (Vegetable) Preparing and Cooking, and Filling and Sealing.

CARBONATED WATERS AND SOFT DRINKS.

The Census gives no figures concerning this industry. Our investigations covered 3 establishments, in 2 cities, employing a total of 24 workers, all males. The processes of concern were (Carbonated Water) Compounding and Bottling.

CONFECTIONERY.

The Census gives 114 establishments engaged in the manufacture of confections, employing a total of 2,493 wage-earners, or 0.6% of the total wage-earners in the state. Our investigations covered 14 establishments in 3 cities, employing a total of 1,266 wage-earners, of whom 362 were males and 904 were females. The chief processes of health-hazardous character were found to be: Confectionery Processes and Chocolate Dipping.

GLASS MANUFACTURE.

The Census gives 45 establishments engaged in this industry, employing a total of 10,159 wage-earners, or 2.3% of the total wage-earners in the state, making it the eleventh industry in importance in point of employes in the state. Our investigations covered 28 establishments, in 16 cities, employing a total of 9,606 wage-earners, of whom 8,742 were males and 864 were females. Under this heading we have included manufacturers of glass table ware, bottles, shades, incandescent blubs (the blowing only), tubing, window glass, ornaments and novelties. Under a separate heading is included the industries engaged solely in glass cutting, mirror making, and art-glass manufacture. The chief processes of health-hazardous character were found to be: Glass Ingredient Mixing, Glass Blowing by Hand, Glass Blowing by Machinery, Glass Pressing, Glass Cutting, Grinding and Polishing, Glass Etching, Glass Crucible Manufacture (about the same as Sagger Making and Mold Making in Pottery, *q. v.*), and Art Glass Manufacture.

According to the Ohio Vital Statistics Reports for the years 1910, 1911 and 1912, there were 188 deaths among glassworkers, of which number 40 were due to tuberculosis, or 21.28% of the total deaths. Thirty-five of the deaths were due to tuberculosis of the lungs. This rate is to be compared to the pulmonary tuberculosis death rate of all occupations in the State combined, for the same years, which was 13.3%; and is also to be compared to the pulmonary tuberculosis death rate of those engaged in Agricultural Pursuits during the same period. which was 7.13%.

ICE MANUFACTURE.

The Census gives 97 establishments engaged in this industry, employing a total of 892 wage-earners, or 0.2% of the total wage-earners in the state. Our investigations covered 12 establishments, in 3 cities, employing a total of 280 wage-earners, all males. This does not include Ice Manufacture by Breweries (see Liquors, Malted). The

chief processes of health-hazardous character were found to be: Ice Manufacturing, and, in the case of some firms, Bottling.

IRON AND STEEL BLAST FURNACES.

The Census gives 40 establishments engaged in this industry, employing a total of 7,295 wage-earners, or 1.6% of the total wage-earners in the state. Our investigations covered 6 establishments, in 3 cities (in addition to those noted in connection with Iron and Steel Rolling Mills), employing a total of 2,100 wage-earners, all males. The chief processes of health-hazardous character were found to be: Blast Furnacing and Gas-producing.

IRON AND STEEL FORGINGS.

The Census gives 30 establishments engaged in this general industry, but does not state the number of wage-earners. Our investigations covered 8 establishments, in which a large percentage of workers were engaged at forging or welding, in 5 cities, employing a total of 886 wage-earners, of whom 875 were males and 11 were females, the latter engaged in core-making. The chief processes of health-hazardous character were found to be: Iron Founding, Core-Making, Puddling, Forging and Blacksmithing, Machine Shopping, Welding, Riveting, Tempering, Wood-working.

IRON AND STEEL WORKS AND ROLLING MILLS.

The Census gives 75 establishments engaged in this industry, employing a total of 38,586 wage-earners, or 8.6% of the total wage-earners in the state; in point of wage-earners this is the second industry in the state. Our investigations covered 23 establishments, in 13 cities, employing a total of 28,195 wage-earners, all males. (These figures include 524 at galvanizing, in 7 firms.) Also the galvanizing (103 males) and tinning (104 males and 12 females) departments in 3 other large firms were seen. The chief processes of health-hazardous character were found to be: Blast Furnacing, Bessemer Furnacing, Open Hearth Furnacing, Gas-producing, Iron Founding, Brass Founding, Welding, Tempering, Metal Grinding, Machine Shopping, Forging and Blacksmithing, Furnacing, Hot Rolling and Shaping, Cold Rolling, Painting and Stenciling, Core-Making, Wood-working, and Chemical Manufacturing. See also Wire Manufacture, Foundry and Machine Shop Processes, Galvanizing and Tinning.

According to the Ohio Vital Statistics Reports during the years 1910, 1911 and 1912, there were 710 deaths reported among Iron and

Steel Workers, of whom 72 died of pulmonary tuberculosis, or 17.69%. This rate is to be compared to the pulmonary tuberculosis death rate of all occupations in the State combined, for the same years, which was 13.3%; and is also to be compared to the pulmonary tuberculosis death rate of those engaged in Agricultural Pursuits during the same period, which was 7.13%.

(See Special Report of Sick Benefit Association of an Iron and Steel Company — Part IV., Introduction.)

LAUNDERING.

The Census gives no figures concerning this (non-manufacturing) industry. Our investigations covered 28 establishments, in 4 cities, employing a total of 2,394 wage-earners, of whom 527 were males and 1,867 were females. The chief processes of health-hazardous character were found to be: Listing, Sorting and Marking, Washing, Mangling, and Ironing. A few laundries were also engaged in Dry Cleaning and Dyeing (*q. v.*).

According to the Ohio Vital Statistics Reports during the years 1910, 1911 and 1912, there were 149 deaths among Laundresses, of which 35 were due to pulmonary tuberculosis, or 23.49% of their deaths. This rate is to be compared to the pulmonary tuberculosis death rate of all occupations in the State combined, for the same years, which was 13.3%; and is also to be compared to the pulmonary tuberculosis death rate of those engaged in Agricultural Pursuits during the same period, which was 7.13%.

A number of laundries were found to have good lunch rooms or restaurants (supplying coffee free), lockers and clothes rooms; also to have anti-spitting placards pasted up, and otherwise to take a decided interest in the health and welfare of their employes.

MALT LIQUORS (BREWING).

The Census gives 105 establishments engaged in this industry, employing 4,356 wage-earners, or 1.0% of the total wage-earners in the state. Our investigations covered 11 establishments, in 3 cities, employing a total of 1,055 wage-earners, all males. The chief processes of health-hazardous character were found to be: Brewing, Bottling, Keg Filling, Washing, and Ice Manufacturing.

The following is abstracted from an Editorial in The Brewery Workers' Journal, January 17, 1914:

Our Dead in 1913. The number of deaths occurring among the members of our International Union for the year 1913 is considerably higher than in the

year previous. The cause for this seemingly unfavorable condition is the fact that last year those local secretaries who formerly did not pay close attention to their duties, have sent in their death notices more promptly. So for the first time since these statistics are published it can be said that the figures given below are as nearly correct as possible.

Reports of 732 deaths were received from 179 local unions with an average membership during the year of 42,218. The death rate is accordingly 17.34 per thousand, or 3.11 per thousand higher than in 1912, where 180 local unions with a membership of 40,895 reported 581 deaths, or 14.23 per thousand.

The six leading causes of death during 1913 were: Consumption, accident, pneumonia and bronchitis, heart disease, cancer and liver and kidney trouble. Then follow suicide, dropsy, stomach trouble, paralysis, heat, appendicitis, rheumatism, murder and old age, in the order named. In the following tables the figures given in parenthesis are those for 1912.

Of the 732 deaths reported, there were caused by:

Consumption	167—22.81%	(124—21.34%)
Accident	89—12.16%	(78—13.43%)
Pneumonia and Bronchitis	87—11.88%	(50— 8.81%)
Heart Disease	73—10.00%	(78—13.43%)
Cancer	39— 5.33%	(17— 2.92%)
Liver and Kidney Complaint	35— 4.78%	(34— 5.85%)
Suicide	30— 4.10%	(28— 4.82%)
Dropsy	29— 3.96%	(25— 4.30%)
Stomach Trouble	21— 2.87%	(11— 1.89%)
Paralysis	19— 2.59%	(20— 3.44%)
Heat	5— 0.68%	(4— 0.69%)
Appendicitis	5— 0.68%	(4— 0.69%)
Rheumatism	5— 0.68%	(9— 1.55%)
Murder	3— 0.41%	(2— 0.34%)
Old Age	2— 0.27%	(3— 0.53%)
Miscellaneous Diseases	87—11.88%	(73—12.56%)
Cause of Death not given in report	36— 4.92%	(21— 3.61%)

There died at the age of:

Under 20 years	7— 0.96%	(2— 0.34%)
Between 20 and 30 years	79—10.79%	(59—10.16%)
Between 30 and 40 years	141—19.26%	(124—21.34%)
Between 40 and 50 years	243—33.20%	(197—33.90%)
Between 50 and 60 years	192—26.23%	(133—22.89%)
Over 60 years	62— 8.47%	(49— 8.44%)
Age not given in report	8— 1.09%	(17— 2.93%)

The deceased were of the following descent:

German	430	(369)
Irish	109	(65)
American	103	(62)
Austrian	14	(10)
Swiss	10	(8)
Bohemian	10	(13)
All others	56	(50)

Rheumatism caused the death of five members—three brewers, one bottler and one laborer. Five members succumbed to excessive heat—one brewer, one bottler, one driver, one fireman and one cooper.

The percentage of the three most numerous categories of brewery workers participating in the six leading causes of death during last year is as follows:

Of the 246 deaths among brewers, 166, or 67.46%, were caused by—

Consumption	59—23.98%	(35—17.00%)
Accident	32—13.00%	(25—12.12%)
Cancer	23— 9.35%	(.. ....)
Pneumonia	22— 8.94%	(19— 9.23%)
Heart Disease	22— 8.94%	(37—17.96%)
Liver and Kidney Complaint	8— 3.25%	(10— 4.86%)

Of the 212 deaths among drivers, 150, or 70.75%, were caused by—

Consumption	46—21.70%	(33—18.96%)
Accident	31—14.62%	(32—18.39%)
Pneumonia	30—14.15%	(16— 9.20%)
Heart Disease	23—10.85%	(18—10.34%)
Liver and Kidney Complaint	15— 7.08%	(10— 5.75%)
Cancer	5— 2.35%	(.. ....)

Of the 125 deaths among bottlers, 79, or 63.20%, were caused by—

Consumption	28—22.40%	(29—31.52%)
Pneumonia	14—11.20%	(10—10.87%)
Heart Disease	14—11.20%	(10—10.87%)
Accidents	11— 8.80%	(5— 5.43%)
Liver and Kidney Complaint	8— 6.40%	(5— 5.43%)
Cancer	4— 3.20%	(.. ....)

While in 1912 dropsy was among the six leading causes of death, in 1913 cancer was more frequent. The order of the ten most frequent causes of death are as follows: Consumption, in 1913, 1 (in 1912, 1; accident, 2 (2); pneumonia, 3 (4); heart disease, 4 (3); cancer, 5 (9); liver and kidney complaint, 6 (5); suicide, 7 (6); dropsy, 8 (7); stomach trouble, 9 (10); paralysis, 10 (8).

SOAP MANUFACTURING.

The Census gives 44 establishments engaged in this industry, employing 1,774 wage-earners, or 0.4% of the total wage-earners in the state. Our investigations covered 12 establishments, in 3 cities, employing a total of 2,020 wage-earners, of whom 1,578 were males and 442 were females. The chief processes of health-hazardous character were found to be: Soap Manufacturing and By-Products, Mixing Chemicals, Oil Refining, some specialty processes as well as Machine Shopping, Wood-working, Printing and Labeling.

WIRE AND WIRE WORK.

The Census gives 66 establishments engaged in this industry, but does not state the number of wage-earners. Our investigations cov-

ered 6 establishments, in 4 cities, employing a total of 1,972 wage-earners, of whom 1,908 were males and 64 were females. Of these plants 2 were engaged in the manufacture of wire and 4 in wire products. The chief processes of health-hazardous character were found to be: Furnacing, Hot Shaping, Wire Drawing, Fluxing (Flour-Water Vats), Pickling, Tinning, Electroplating, Galvanizing, Painting, Iron Founding, Brass Founding, Machine Shopping, and Woodworking. (See also Foundry and Machine Shop Produces.)

INDUSTRIES IN WHICH THERE IS A LIABILITY TO CONTRACTING COMMUNICABLE OR INFECTIOUS DISEASES.

It is impossible to attempt to cover all of the relations between communicable diseases and industry, or even to touch upon all of the most important.

We give in this place the results of some special studies and some casual observations which have been made in the State during the period of this survey.

INDUSTRIAL TUBERCULOSIS.

(Reprinted from Monthly Bulletin, Ohio State Board of Health, April, 1914.)

Industrial tuberculosis is a term which is being used to associate the occupation of an adult person as a distinct factor in the causation of his or her consumption. In the propaganda against the great white plague, every effort conceivable is being directed toward the bettering of housing and living conditions, the correction of habits and the elimination of moral hazards. Almost to the present time little constructive thought has been given to the 10 hours or so which the individual spends in occupational pursuit. If foul air, abnormal humidity, fatigue, inactivity, poisons, etc., predispose to tuberculosis between 6:00 P. M. and 6:00 A. M., must they not also during the day when heat and dust are also added, and respiration and other vital processes are much accentuated?

This situation is remarkable, for a little investigation shows that where the factors at which the propagandists are chiefly aiming remain constant, and perhaps excellent, workers in certain pursuits succumb to tuberculosis in numbers suggesting a black plague. For example, professional men, men and women in agricultural pursuits, millers, quarrymen and carpenters have a death rate from consumption, which according to statistics, lies between 6.6% and 10.1%. On the other hand, clerks, book-keepers, telephone girls, stenographers, teachers, textile-workers, tobacco-, glass-, brass-, rubber-, and pottery-workers, printers, stone-cutters and the like, range between 19 and 43%.

In our present concept, tuberculosis is due to—

(1) The presence of the *Bacillus Tuberculosis.* Carelessness makes it almost omnipresent.

(2) Predisposition, which covers heredity and congenital defects,

(3) Infantile and early childhood infection, when the disease is highly communicable, but deaths are comparatively few.

(4) Health hazards, which customs, ignorance and bravado suddenly magnify during the youth of both sexes, and which so lower the resistance as to re-awaken the childhood infection or invite—

(5) Adult infection. This seems only possible when damaged lung tissues receive a constant infection through the air.

By all means (1), (3) and (4) are the mighty factors. With industry we find that although the vast majority of persons have received their infec-

FIG. 33. INDUSTRIAL TUBERCULOSIS.

Middle-aged skilled workman incapacitated by consumption, the chief promoting factors being dust and fumes in his work.

tion during infancy and childhood (perhaps 90%), the factor (4), which begins with, and is so infinitely bound up with industry, to which may, perhaps, be added (5) — so often due to over-crowding in industrial places, the lack of cuspidors, and the presence of the consumptive spitter—these two explain why the girl who remains at home, or the man who follows a fresh air industry, as in the quarry, are comparatively immune, whereas the sister and brother in the office, factory or mill appear to be shorn of resistance.

ILLUSTRATION OF WHAT IS MEANT BY INDUSTRIAL TUBERCULOSIS.

(Reprinted from Monthly Bulletin, Ohio State Board of Health, September, 1914.)

We give below the results of a routine investigation of a plant according to the outline of industrial health-hazards as published in the April issue of this BULLETIN. After a perusal of the findings given, which are those of an actual case, is there any wonder that six cases of consumption have been reported to the State Board of Health within a few months' period among the workers in this establishment!

Features.	*Health-Hazards.*
Establishment	X.
Location	C.
Industry	Woodworking.
Employes	390 men, 50 youths under 20.
Modern methods	Fairly so.
Unionism	Open Shop.
Attitude toward workers	Indifferent.
Type of workers	Largely ignorant foreigners.
Retention of workers	Not good.
Health appliances	A blower system, but not kept in working order.
Health instructions to employes	None.
Sick benefits, etc	None.
Death benefits	Small order, maintained by employes.
Work hours	10 per day, one-half hour noon, no other recesses.
Overtime	Occasional.
Number of skilled workmen	Only small per cent.
Age groups	Under 20—50; 20 to 40—310; over 40—30.
Construction of building	Old factory type, low ceilings, many dark quarters.
Workers at one process exposed to hazards of another	About 100.
Dust	Wood dust, air thick with it.
Dirt	Floor, walls and windows apparently rarely cleaned.
Dampness	No.
Darkness	Three-fourths of workers are in poorly lighted quarters.
Air	Still, close, stuffy.
Heat	No factor.
Cold	No factor.
Fatigue	Fair amount due to piece work, speeding up, constant standing, faulty postures, jarring processes, body pressures and loud noises.
Inactivity	Negative.

Features.	*Health-Hazards.*
Infection	Great liability due to crowding, use of common cups, towels, improper washing places and closets, spitting on floors, absence of cuspidors, frequent trivial injuries, no selection of workers, no physical examination, no medical supervision.
Poisons	Negative.
Alcoholism inducement	Great, due to poor quality and meager supply of drinking water, to proximity of saloons, heedlessness of employer, absence of workers' efficiency department, and to subjection to dust, dirt, darkness, bad air and fatigue.
Workmen's complaints	Chiefly, constant breathing of dust, compelled to work alongside of men who are consumptive and careless in habits.
Diseases reported to State Board of Health	SIX CASES of consumption within a period of 4 months time.

Two dangerous health-hazards should be abolished at once in this establishment. The first is wood dust, which, though the plant is fairly well equipped with blower systems, is allowed to escape into the air because it is nobody's business in the plant to see that the blower systems are in continual working order. The second great hazard is the lack of a medical supervision of the employes to root out the consumptives who are still at work with no cuspidors in which to spit out their tubercular sputum. There are some other health-hazards which should have attention, but these constitute the major ones.

TRACHOMA OR GRANULATED EYELIDS.

The following is taken from an editorial in the Jour. A. M. A., May 16, 1914, page 1564, while the "Conclusions" and "Recommendations" are taken from the original article in Public Health Reports, Vol. 29, No. 10, March 26, 1914:

"During the past few years reports regarding trachoma among the reservation Indians and the mountain population of Kentucky and other states have stimulated interest in this disease. Investigation has shown that it affects many communities, to a greater or less extent, existing in a number of instances among school children. Attention has been directed to the great industrial establishments where large numbers of foreign laborers are employed. In each instance, when a focus of the diesase has been found, its origin has been carefully investigated so that preventive measures might be instituted. J. W. Schereschewsky of the Public Health Service has examined the 5,962 employes of the Youngstown (Ohio) Sheet & Tube Company with reference to the prevalence of trachoma. He found among them seventy-six cases, a rate of prevalance of 1.3 per cent. Nineteen cases of suspicious conjunctivitis were

also observed. Of the employes 28.5 per cent were Americans. Among the 1,700 Americans the rate of prevalence was 0.23 per cent. and among the seven foreign nations represented the rate ranged from 0.9 to 3.0. After careful inquiry as to the time these men had been in the United States, Schereschewsky expresses the opinion that with but few exceptions the disease was contracted subsequent to landing in this country, and in the great majority of instances while the men were employed in East Youngstown. It was not thought that the disease had been spread to any great extent by conditions

FIG. 34. GRANULATED EYELIDS.

Partial blindness due to trachoma or granulated eyelids—a disease easily spread by common towels, also by allowing a worker having the disease to attempt to remove a foreign body from the eye of a fellow-worker.

in the mills. Close physical contact and the use of the common towel and hand basin are known to be favorable to the spread of trachoma, but these conditions do not prevail in the works of the company. Most of the foreigners do not wash in the mills, and those Americans of the skilled labor class who do, have their own buckets or vessels and towels. One possible source of infection in the mills is the habit of the workmen of removing from each other's eyes foreign bodies that may lodge therein, although they are instructed to apply to the medical service for relief. Attention was directed to the living

conditions of the workers, and here Schereschewsky discovered the chief source of infection. Many of the lodging-houses of the workers were much overcrowded. Thus, in one instance twenty-three lodgers were found in a four-room house, as many as ten or twelve in one room. Insanitary conditions prevailed in East Youngstown as well as in the immediate surroundings of the men. The presence of recent cases showed that the disease was gradually spreading from foci of chronic cases in a state of acute exacerbation, some of which Schereschewsky observed. In most instances, perhaps, as at East Youngstown, the cases are among laborers from foreign countries who have been in the United State a comparatively short time. The inspection at the ports of entry serves to detect practically all cases that have reached a stage at which diagnosis is possible; an immigrant when he lands may have the infection in such an undeveloped state that it cannot be detected and he may then in a short time become a focus for the spread of the disease. The employers of labor in the great industrial establishments should be warned of the seriousness of trachoma, and especially of its liability to spread. The health authorities of the cities and towns where these establishments are located should realize their responsibility in this matter. Bad housing, overcrowding and lax personal and community hygiene will contribute to the spread of this highly infectious and disabling but wholly preventable disease.

CONCLUSIONS.

1. The origin of the prevalence of trachoma among the employees of the Youngstown Sheet & Tube Co. is readily accounted for by the presence among them of chronic cases of the disease, some of which are even now in a state of acute exacerbation.

2. The crowded insanitary condition of the lodging houses, where a large proportion of the employees live, amply accounts for the spread of the disease.

3. The presence of recent cases of trachomatous infection shows that under existing conditions the disease is gradually being spread. Unless measures are now undertaken for its control the prediction seems justified that the disease will gradually gain such headway as perhaps to prevail in epidemic form.

4. It seems evident that so long as the present insanitary conditions obtain in East Youngstown the control of trachoma will be difficult or impossible unless measures to this end go hand in hand with betterment in the local sanitary conditions.

5. The present machinery for the control of the situation is unsatisfactory. The local health officer of East Youngstown is a layman, without the knowledge or training in sanitation to enable him to cope with the situation.

The town itself lacks completely the fundamentals for sanitation, namely, a public water supply, water carriage sewerage system, system of garbage collection and disposal, physical supervision of school children, proper grading of streets, and provision for the disposal of the surface washings and storm waters, even the numbering of houses, so that the location of cases of communicable diseases can be recorded. There are also no local dispensaries or hospitals, except the emergency hospital of the Youngstown Sheet & Tube Co., which is located in the plant.

RECOMMENDATIONS.

In view of the fact that some 80 per cent of the taxes of East Youngstown are paid by the Youngstown Sheet & Tube Co., and that 60 to 70 per cent of their personnel, including nearly all the foreign element, live in East Youngstown, it would seem as though the Youngstown company is more directly interested in the sanitary conditions in East Youngstown than anyone else.

The efficiency of its employes is affected, not only by their environment when at work but also by that of their homes. It is evident that when workmen are exposed to insanitary surroundings during their period of rest, not only do they incur the danger of contracting communicable diseases but their ability to recuperate from their previous labor is adversely affected by the prevailing unhealthful conditions.

Any effective treatment of the situation must necessarily include specific measures to be adopted at the mills and also the betterment of the sanitary conditions in East Youngstown if permanent results are to be secured.

The recommendations made, therefore, related to two separate ends; first, the treatment of the situation at the mills and, second, the sanitation of East Youngstown.

Besides calling the attention of the company to the usual means for preventing trachoma, such as avoiding the use of the common towel and hand basin and the use of the same bed by two or more individuals, the following special recommendations were made for the company to put into effect at once:

1. No time should be lost in securing a competent physician on full time, at an adequate compensation, who should perform the following duties:

(*a*) Make a complete mental and physical examination of persons applying for employment with the company.

(*b*) Give competent treatment to any individuals found to be afflicted with trachoma or other communicable diseases.

(*c*) If the necessary arrangements could be made this physician could also be the health officer for East Youngstown and supervise its sanitary condition.

2. A competent graduate trained nurse should be secured who would be able to administer treatment to trachoma cases under this physician's direction.

3. All individuals named in a list furnished the company who are suffering from trachoma, and with respect to whom the notation "acute," "recent," or "severe" was made, should be segregated, preferably in some building controlled by the company, and there furnished competent medical treatment until such time as the infectiousness of the disease has been removed. They could then be allowed to return to work conditionally upon their reporting daily to the hospital for inspection and treatment.

4. All persons suffering from trachoma, including those segregated in the manner just referred to, should, upon their return to work, be required to report for inspection and treatment twice daily at the hospital. It was suggested, in order to secure easy compliance with this recommendation, that these persons secure their time cards at the hospital and the fact of their having there reported, on going in and out, be attested by a special stamp kept at the hospital.

5. In order to prevent the development of subsequent cases, foremen, or those in charge of gangs, should be required to submit semi-weekly reports

as to the appearance of the eyes of men under their control. Such reports should not be perfunctory, but should state affirmatively or negatively whether they have observed any cases of reddened or sore eyes in any of the men under their charge. Whenever the eyes of any workmen appear red or sore such workmen should be sent at once to the hospital for examination.

The following recommendations as to the improvement of the sanitary conditions of East Youngstown were made, their realization to constitute part of the future policy of the company, as an equivalent for the large taxes paid by the corporation:

1. The provision of an adequate and pure water supply.
2. The installation of a water-carriage sewer system.
3. The abolition of insanitary privies.
4. The installation of catch basins and sewers for disposal of storm waters.
5. The installation of a system of garbage collection and disposal, with ordinances as to the use of sanitary garbage cans with tight-fitting covers.
6. Restriction of overcrowding in lodging houses and regulation of their sanitary condition by a system of licensing and inspection.
7. Numbering of houses and grading of streets.
8. Physical supervision of the children in the schools.
9. The appointment of a properly qualified physician as health officer.
10. Establishment of a hospital and dispensary in East Youngstown.

[NOTE.—It is gratifying to learn from a letter received from Mr. Woltz, the director of safety of the Youngstown Sheet & Tube Co., that the recommendations in regard to the treatment of trachoma cases have already been carried into effect.]"

HOOKWORM DISEASE.

We have been unable to attack this problem at all, principally because of the long continued coal miners' strike. Coal mining is the most likely industry in the state with which it is associated. This subject, also, would require a rather intensive study, occupying at least several weeks, and requiring the time of two physicians from the office during most of that time.

Since the disease is very prevalent in Kentucky and West Virginia, there is hardly any question of its existence, at least in the southern counties of Ohio. There is some question, however, of its extent among coal miners or other workers in this State, since the methods and processes of mining are quite dissimilar to those carried on in Virginia, the principal difference being that all Ohio mines are slope or drift mines instead of shaft mines, and while there are a great many mines, none are individually very extensive.

The following is copied from the Annual Report of the Ohio State Board of Health for the year 1913, p. 718, and serves to show the existence of the disease in the State at a point about half-way between Cleveland and Columbus:

"On August 2, 1913, in compliance with the request of a physician, the epidemiologist visited Washington Township, Holmes County, to investigate some supposed cases of ankylostomiasis.

"His report follows:

"A physician from Loudonville found a number of persons in Washington Township, Holmes County, who were suffering from a low grade anemia. These patients had a staring expression, showed great weakness, pot belly and other symptoms suggestive of hookworm disease. The history of these cases showed that the first case had contracted the disease in Indiana, where he suffered from a pustular affection of the soles of the feet. About three months afterwards symptoms of his present illness developed. Shortly afterwards his wife and daughter contracted the disease.

"The house in which this family live is in an extremely insanitary condition. Sewage is disposed of in a privy which contaminates the surrounding soil. The avenues of infection are, therefore, open. An examination of these patients was made and revealed tenderness in the right iliac region besides the signs and symptoms before mentioned. Bloodsmears were taken from these patients and examination of these revealed a considerable degree of anemia and an increase in the percentage of eosinophils. Specimens of stool were also taken and active parasites (Necator Americanus) and ova were found. The evidence is, therefore, complete that these patients are suffering from ankylostomiasis.

"The local authorities were advised of the presence of this disease and recommendations were made with a view to determining the presence of other cases, of controlling all known cases, and to place privies and cesspools in such condition that the infection could not be transmitted as at present. The patients were also instructed in the methods necessary to prevent them disseminating the disease. The physician was advised as to the proper treatment of such cases and he planned to begin thymol administration in accord with Stiles' method at once.

"These cases are of great interest as the first to be reported to the State Board of Health in Ohio."

ANTHRAX INFECTION.

During the year 1913 there were 3 cases of death reported to the Vital Statistics Department of the state in which anthrax was mentioned as a complication. Two further cases (not fatal) were called to our attention during 1914. A little investigation of these instances brought us to the conclusion that none were authentic, because two of them were associated with diabetes, and another with kidney disease. The subsequent histories of the two remaining, which were associated with the cutting of meat, and in which peculiar ulcers developed upon the thumbs, disproved their character as anthrax. Furthermore, we are informed by the authorities in charge of the Department of Animal Husbandry, at the Ohio State University, that no cases of anthrax have been reported among animals in the State in recent years. The experience of wool-sorters is given under that head.

TETANUS OR LOCK-JAW.

The occurrence of tetanus or lock-jaw is referred to under "Junk." There are a large number of industries and processes, also, having to do with the liability of getting dirt, horse manure, hairs from hides, etc., into punctured wounds or lacerations, in which workers are more liable to the germs of lock-jaw than ordinarily.

FURUNCULOSIS OR PUS INFECTION FROM OIL.

The following is taken from an investigator's report upon the National Acme Manufacturing Company, of Cleveland, Ohio, under date of September 26, 1913:

"Two years ago a rather extensive outbreak of furunculosis occurred among employes. One thousand gallons of lard oil is used per month in the various cutting processes, and 50% of the employes have their hands and forearms constantly smeared with oil while working. The cause of the outbreak of furunculosis was traced to the oil, and a bacteriological examination made at that time showed the oil to be contaminated by a pur-forming organism. Oil sterilization department was then installed and careful inspection of at least 400 men today failed to show any evidence of furunculosis. Process is as follows: Oil is brought from all departments in buckets to several large centrifuges on the upper floor. Here it is centrifuged, the solid material being separated from oil itself. This solid material represents cuttings, etc. The oil flows by gravity from these separators to a collecting tank in basement. It then passes through a series of upright cylinders called 'settling tanks' and in this way an additional amount of sediment is allowed to settle to the bottom of tanks where it is drawn off as waste. From the last settling tank in series the oil passes to sterilizing tanks which are connected in multiple and which contain steam coils. From the last sterilizing tank the oil passes into storage and is undoubtedly free from germs. It is used again and again, fresh oil being added to make up for losses."

INDUSTRIAL APPENDICITIS.

While appendicitis is not a communicable disease it is so favored as to be communal in certain industries. Our attention was called to its frequency in many of the lead industries investigated, where the associated constipation and spasms of the intestines undoubtedly brought the attack on.

Appendicitis associated with constant reduplication of the selfsame movements with the right foot and leg is illustrated by the series of cases mentioned under Factory Processes.

INDUSTRIAL TYPHOID FEVER.

Report of an Epidemic at Springfield, Ohio, in 1911.

"Twelve cases of typhoid fever attributed to untreated creek water were in the employ of the International Harvester Machinery Company. This company has two principal sources of water supply, one the city water, and the other untreated creek water. These two supplies are separated only by a valve in the main. The creek water is used only in cases of emergency, when the city supply fails as it has frequently done in the past. It is notorious that a double water supply such as is used by this company is a danger to those consuming it, if one of the sources is not free from contamination. A valve will leak, depending upon the relative pressures of the water on either side of it; and in this case the untreated creek water was always at a higher pressure than the city supply. The valve will also be opened occasionally in cases of emergency and the employes will not consider this but will continue using the water and so ingest bacilli received in the water from the discharging sewer. The use of such an arrangement has proven a fruitful source of infection in other places in the past.

"Another clue which rather pointed to the fact that the plant was responsible for the infection of the twelve cases ascribed to it, is the fact that the disease among the employes occurred in the form of an epidemic, in October and the early part of November, pointing to a temporary infection of some vehicle used in common by the workmen. No other cause save the water was discovered in any case, and the evidence is very strong in favor of this mode of transmission."

INDUSTRIAL AND COMMUNAL TYPHOID FEVER.

"Report of an Outbreak of Typhoid Fever in the Quarry Districts at South Amherst, Ohio.

"On April 14, 1914, in compliance with the request of a physician, the epidemiologist visited South Amherst in Amherst Township, Lorain County, to investigate an outbreak of typhoid fever.

"His report follows:

"South Amherst is a small non-incorporated community built up around the quarries in Amherst Township. The population is probably about five hundred. A case of typhoid fever which was rather atypical developed in January. During the convalscence of this patient four other members of the family contracted the disease. From this family it spread to one of the neighbors and until up to the present time there have been twenty-two cases and two deaths among five families. In the first case those in attendance upon the child who had typhoid fever threw the discharges untreated upon the ground leading to the well. The wells in the village are, as a rule, quite accessible to the surface pollution of all kinds and the privies are so constructed that the soil surrounding them is contaminated for long distances. The limestone formation allows pollution to travel for long distances along the crevices without any oxidation or other purification.

"There are five cases of typhoid fever at the present time in one family. The cases were examined and found typical of moderately severe attacks of

typhoid fever. One of the patients was in a hospital at Lorain and had had hemorrhages.

"The employes of the quarries are, as a rule, foreigners who do not understand the ordinary principles of cleanliness and sanitation. It is extremely difficult to instruct these people in the proper care of the sick so that disease will not be spread by personal contact. It would be an extremely difficult matter also, to place all wells and other sources of water supply in a sanitary condition and it would be even more difficult to enforce the construction of sanitary privies in all cases. It seemed advisable in the present situation to adopt a different procedure and to attempt to immunize as many persons in South Amherst as possible as the preliminary step. Toward this end, communications were directed to the officials of the two quarry companies in South Amherst requesting their co-operation in vaccinating their employes with anti-typhoid vaccine. It is recommended that this vaccine be supplied without charge by the State Board of Health and that the physicians employed by the two quarry companies administer the vaccine without charge to the men.

"When this preliminary step is taken, other precautions, such as placing the privies in a sanitary condition and rendering the wells safe from pollution, may be completed."

INDUSTRIES HAVING MISCELLANEOUS HAZARDS NOT INCLUDED UNDER PREVIOUS HEADINGS.

COAL MINING.

The U. S. Census (1910) gives the following figures for the coal mining industry in the State of Ohio:

No. of coal miners reporting to state	551
No. of superintendents, salesmen, clerks	980
No. of operators	44,056

The survey did not cover this industry for several reasons. The occupational diseases of coal-miners are of such a nature as to require an intensive study of each of them to draw any definite conclusions. It was considered best, therefore, to devote the time and funds at hand first to the manufacturing industries. When the time was opportune for the coal mining survey, the general strike closed all the mines for a long period. The influence of this upon occupational afflictions was and is such as not to warrant a survey until work has been continuously resumed for some months at least.

The principal occupational afflictions to which miners, in the types of mines which are worked in Ohio, are most liable are: respiratory diseases (pneumonia, anthracosis, pulmonary cirrhosis, emphysema, phthisis, pleurisy, and middle ear disease); hook worm disease; typhoid fever; trachoma or granulated eyelids; nystagmus or dancing pupils; "beat hand"; "miner's elbow"; while the effects of sulphur fumes upon the lungs, skin and eyes should be inquired into.

The Ohio Vital Statistics Reports for the years 1910, 1911 and 1912 give a total of 1,484 deaths among miners. Tuberculosis is the only disease which is specifically applied to these deaths. There were 114 deaths from pulmonary tuberculosis, or 7.68% of the total deaths. This compares very favorably for the rates among all occupations combined (13.3%) and also for Agriculturists (7.13%). This is in harmony with similar statistics for coal-miners the world over, i. e., that they have a low death rate from consumption itself, although respiratory diseases of other nature are excessive. In this connection it is well to point out that accidents and injuries claim 38.8% of Miners and Quarrymen in the registration area of the United States, and, as Dr. Wm. Ogle of England says, "A man who is killed by an accident cannot also die from phthisis or other disease."

Since coal mining is a long period occupation (that is, it is a trade which persons remain at presumably between the years of 15 and 60 or the entire work life) it is significant to point out that the average age at death of 464 miners in Ohio, in the year 1911, was 49.3 years, or some 12 or 13 years less than the expected length of life.

BARBERING.

According to the Ohio Vital Statistics Reports for the years 1910, 1911 and 1912 there were 454 deaths among barbers; of these 105, or 23.12%, were due to pulmonary tuberculosis. This is considerably higher than the rate for all occupations combined (13.3%) and, particularly, Agriculturists (7.13%).

This trade was not included in the field work of the survey, but the most acceptable explanation for these rates is the indoor (often basement) confinement with long hours, breathing the breaths of patrons whom they lean over, and the breathing of fine hairs. Barbers also have skin troubles from the solutions which they use, and flat foot from prolonged standing (still).

CAISSON WORK.

Caisson work was carried on in a small way in the city of Cleveland during the course of the survey, in connection with the building of the city water tunnel where a total of 45 men were employed, and in connection with the city sewer where a total of 8 men were employed. . The workers were divided into miners who were skilled men, muckers who removed the earth which had been dug out, and masons who bricked up after them, usually at night time. In both places the work was done under a pressure of from 15 to 20 pounds only, so that the hazard was not great. The men were required to come to the

surface to use the toilets. When the pressure was brought to normal there was considerable condensation of moisture so that it became very chilly, especially for workers who had been perspiring. We quote below from the report of the Cleveland investigator:

"The construction work (of the water works tunnel) is supervised by Mr. ———— who has been engaged in the work all his life, and he said that it was his ambition to construct this tunnel without the loss of a single life. At the entrance of the tunnel they had a compressed air chamber, so that if a man feels the effect of his work under compressed air, he is brought in this chamber which is a tube 7 ft. in diameter and 10 ft. long, containing a cot. It is sealed at one end and has a door at the other. Here they can put a man under 18 pounds pressure. I had them put me in it and increase the pressure to this point, and felt some pain and roaring in my ears, but otherwise experienced no ill effects. It seems that if the pressure is increased or decreased gradually there is practically no ill effects and the amount of pressure the men work under depends upon the character of the soil they are excavating, a soft ground needing more than a heavy clay or shale. To get to the site of the works one is carried through an old tunnel which is 7 ft. in diameter, on a small tramway for a couple of miles where they are building the 10 ft. tunnel. This tunnel is at present about 100 ft. long. To get into this part you are brought in a small chamber where the air is brought up to 15 pounds, and upon the man who operates depends largely the effects of the compressed air. If he is in a hurry as is very often the case, he will let you in or out accordingly before you are adjusted to the change.

"I saw one man out there who, 10 years ago, was working under 37 pounds and who was released in 1½ minutes, and he is partially paralyzed and uses two canes to get about. At the head of this tunnel is a crib (No. 2) and the men come up here to the toilet, which consists of some flat rocks abutting over the lake. The tunnel is 50 feet under the bed of the lake. All the men working there, with few exceptions, are experienced and have worked in several other places with Mr. ————. I questioned a number of them and several had had pains in their legs recently when changed too rapidly. A new man had had a slight attack a few days before. The tunnel is damp and chilly and I took a bad cold from my trip.

"I found that by chewing gum and swallowing, it was easier to become accustomed to the increase in pressure thus by inflating the ears."

RECAPITULATION OF INDUSTRIES INVESTIGATED.

Name of Industry.	No. Est.	No. Cities.	No. Males.	No. Females.	No. Wage-earners.	No. Health-hazardous Processes.*
Poisons.						
Agricultural Implements ...	12	6	4,499	61	4,560	9
Automobiles & Parts.......	34	10	17,404	379	17,783	18
Babbit Metal & Solder......	2	2	8	....	8	1
Bicycles, Sewing Machines.	3	3	2,685	110	2,795	12
Boxes, Fancy & Paper......	4	4	351	230	581	7
Brass & Bronze Products...	55	6	4,450	82	4,532	16
Carriages, Wagons & Materials	53	11	2,443	41	2,484	10
Cars Made By R. R.........	6	4	5,534	....	5,534	11
Cars Not Made By R. R...	7	7	6,459	5	6,464	11
Cash Registers & Calculating Machines	5	2	6,940	532	7,472	14
Chemicals	4	3	1,100	1	1,101	3
Coffins, Burial Cases, etc..	8	5	745	177	922	12
Copper, Tin & Sheet-Iron..	8	5	840	467	1,307	13
Cutlery & Tools...........	25	6	3,949	253	4,202	19
Dry Cleaning & Dyeing....	27	6	263	435	698	6
Electrical Apparatus	29	11	6,576	2,368	8,944	22
Electroplating	8	5	110	....	110	5
Enameling and Japanning..	5	3	102	13	115	9
Engraving & Die-Sinking...	5	3	95	10	105	3
Explosives	7	7	755	239	994	6
Fertilizers	10	4	839	10	849	4
Files	4	3	108	....	108	4
Flavoring Extracts	2	1	16	2	18	1
Foundry & Machine Shop Products	47	11	13,857	627	14,484	29
Fur Goods	4	3	21	23	44	1
Furniture & Refrigerators...	19	8	3,837	116	3,953	12
Gas, Illuminating & Heating.	2	2	55	....	55	3
Galvanizing	2	2	33	....	33	2
Glass, Cutting, Staining, etc.	10	4	329	18	347	9
Hats	2	1	64	102	166	6
Instruments—Professional ..	2	2	120	55	175	6
Iron & Steel Doors & Shutters	1	1	90	....	90	2
Jewelry	3	1	23	....	23	5
Junk	22	4	334	72	406	2
Lead—Bar, Pipe & Sheet...	3	2	34	....	34	1
Leather—Tanned, Cured & Finished	8	4	1,120	....	1,120	3
Lime	7	6	556	....	556	4
Matches	3	3	1,313	469	1,782	7
Mirrors	5	3	89	....	89	3
Musical Instruments	5	3	847	4	851	19
Oilcloth & Linoleum.........	3	3	240	....	240	4
Oil—Linseed & Petroleum..	5	3	1,007	....	1,007	4
Paint & Varnish............	40	6	2,041	338	2,379	6

* General Factory Processes not included.

RECAPITULATION OF INDUSTRIES INVESTIGATED — Continued.

Name of Industry.	No. Est.	No. Cities.	No. Males.	No. Females.	No. Wage-earners.	No. Health-hazardous Processes.*
Patent Medicines & Compounds	1	1	47	48	95	2
Photo-engraving	2	4	36	....	36	4
Porcelain Enameled Iron Ware	5	3	504	....	504	9
Pottery, Terra Cotta, etc.	56	16	6,800	2,694	9,494	12
Printing & Publishing	34	5	2,325	390	2,715	11
Roofing Materials	3	3	135	6	141	4
Rubber Goods	32	14	22,173	2,887	25,060	20
Safes & Vaults	4	3	1,074	....	1,074	9
Salt	1	1	135	15	150	2
Scales & Balances	3	3	650	50	700	10
Shipbuilding & Boatbuilding	3	2	1,480	....	1,480	7
Signs & Advertising Novelties	12	4	790	253	1,043	15
Smelting & Refining	4	2	45	....	45	3
Springs—Steel Car & Carriage	6	4	653	....	653	8
Stereotyping & Electroplating	6	3	229	....	229	4
Stoves & Furnaces	15	9	5,104	56	5,160	16
Tin Plate & Terne Plate	5	5	542	74	616	5
Toys & Games	4	2	569	56	625	9
Total	712	......	135,572	13,768	149,340	......
Dust.						
Brick & Tile	9	7	716	....	716	2
Brooms	10	2	82	4	86	1
Cement Making	2	2	163	....	163	2
Cooperage & Wooden Goods	1	1	390	....	390	6
Cordage, Twine, Jute, etc.	5	3	434	76	510	6
Emery & Other Abrasive Wheels	2	2	112	....	112	4
Flour & Grist Mill	2	1	85	....	85	1
Grindstones	4	3	878	....	878	1
Marble & Stone	19	5	705	....	705	6
Mattresses & Bed Springs	6	5	152	53	205	3
Paper & Wood Pulp	13	7	2,304	663	2,967	10
Wood—Turned & Carved	2	1	81	4	85	4
Total	75	......	6,102	800	6,902	......
Fatigue, Monotony, Etc.						
Boots & Shoes	29	9	6,727	5,079	11,806	5
Clothing & Textiles	17	6	2,277	4,881	7,158	8
Flags, Regalia, etc	2	2	340	609	949	12
Iron & Steel Bolts, etc.	4	2	1,090	494	1,584	7
Tobacco	27	13	1,791	4,463	6,254	9
Total	79	....	12,225	15,526	27,751	......

* General Factory Processes not included.

RECAPITULATION OF INDUSTRIES INVESTIGATED — Concluded.

Name of Industry.	No. Est.	No. Cities.	No. Males.	No. Females.	No. Wage-earners.	No. Health-hazardous Processes.*
Heat, Cold, Etc.						
Bakeries	8	3	653	141	794	1
Canning & Preserving	13	11	685	661	1,346	3
Carbonated Waters	3	2	24	....	24	2
Confectioneries	14	3	362	904	1,266	2
Glass	28	16	8,742	864	9,606	9
Ice	12	3	280	....	280	3
Iron & Steel Blast Furnaces.	6	3	2,100	....	2,100	2
Iron & Steel Forging	8	5	875	11	886	9
Iron & Steel Rolling Mills	23	13	28,195	....	28,195	22
Laundering	28	4	527	1,867	2,394	7
Liquors, Malt	11	3	1,055	....	1,055	5
Soap	12	3	1,578	442	2,020	7
Wire & Wire Work	6	4	1,908	64	1,972	14
Total	172	......	46,984	4,954	51,938	......
Miscellaneous.						
Caisson Work	2	1	53	....	53	1
Total	2	1	53	....	53	1
Recapitulation.						
Poisons	712	......	135,572	13,768	149,340	......
Dusts	75	......	6,102	800	6,902	......
Fatigue	79	......	12,225	15,526	27,751	......
Heat, Cold	172	......	46,984	4,954	51,938	......
Communicable Diseases, Misc. (Caisson Work)	2	......	53	....	53	......
Grand Totals	1,040	81†	200,936	35,048	235,984	......

* General Factory Processes not included.
† Different cities and villages.

PART V.

HEALTH-HAZARDOUS PROCESSES.

THE SCOPE AND METHODS OF INQUIRY.

This section of the report takes up the description of particular processes in the industries and gives a summary of the findings for each. Under "Comments" are stated the principal corrective measures suggested to conserve the health of the workers in such processes. Most of these measures are those which our investigators discovered were being used in the better regulated plants.

It will be seen that this is a very important section of the report since it deals directly with working conditions. While instances are cited throughout this section of persons suffering from occupational diseases, the reader should consult Part VI. to learn the total number of such diseases which have been reported to the State Board of Health during the course of the survey.

From a hygienic point of view there were numerous establishments employing large numbers of wage-earners in which but two or three processes were considered health-hazardous, and these, perhaps, engaged but a small number of employes. On the other hand, many small establishments had most of their employes engaged in processes which were considered more or less dangerous to health. Hence, the size of, and number of employes in an establishment has no relation to the number of dangerous processes nor the relative number of persons engaged in the same.

While a lack of technical knowledge upon the part of the physician-investigator interferred more or less with his ability to describe processes, it did not interfere with his ability to observe the presence or absence of the 10 or 12 health-hazards for which he was seeking in each place, and to report upon the same according to the blank forms and the instructions under which he worked. While errors may have crept into the statements which follow they are invariably upon the conservative side and are usually errors of omission rather than commission. In summarizing, the rule has been followed to give the benefit of the doubt to the figures representing the better conditions. Where the number of "fair" or "bad" conditions only is mentioned, the balance are to be considered "good."

In nearly all the processes here described some reports were received from field workers too late for classification, but any unusual features from such reports have been mentioned herein. In order to have sufficient time to compile the mass of information collected, it was necessary to close up reports upon given processes when a sufficient number had been received. In most instances it is believed there have been enough places and processes described to give a fair representation of general average conditions.

A great many trade processes, both patented and secret, were disclosed to the investigators in full confidence of their proper usage, and we have endeavored in all respects to honor such confidences in the descriptions of processes given here or elsewhere. It has been the aim also to make this report one upon industrial hygiene and occupational diseases, and not one upon the description of manufacturing processes. Inquiries into manufacturing processes have also been made for the sole purpose of determining the amount of risk to the health of the worker. In nearly all cases, indeed, such information was voluntarily given to our representatives even before inquiries were made.

In all establishments visited, which are included in the summaries herewith, work was going on at the time of the visit of inspection. In addition to the observation of working conditions the investigators questioned employes while at work, and examined for the more easily demonstrable "ear-marks" of occupational diseases, devoting as much time to this feature as seemed warranted in most places. The percentage of employers who objected to this, even without explaining to them that such was the prerogative of the Board of Health, under the enabling Act, was so small that this alone, if nothing else, shows the magnanimous attitude of the great body of employers throughout the State. Investigators were carefully instructed in this respect not to pass opinions upon working conditions to employes, nor to express to any employe who was questioned or examined any opinions concerning his or her state of health as determined by the physician-investigator.

The principle adopted throughout this report has been to conceal individual incidents, places, establishments, and even cities, as much as possible, and to render a summary of findings and opinions uninfluenced by local coloring. In nearly all places, names, addresses, ages, health histories, and work complaints, if any, of part of the employes were taken. Both older workers and old employes, as well as newer ones, were so consulted. In some places materials which workmen were handling and the substances of which they did not know (perhaps even employers did not know) were collected and sent to our laboratories for analysis.

For each process the following facts were ascertained:

1. The location of the process in the building.
2. What that part of the building was constructed for.
3. Whether such construction was generally hygienic, that is, amply spaced, properly enclosed against weather conditions, well lighted, properly heated, ceilings high enough, walls, floor and ceilings of a character to be kept easily clean, the conveniency of toilets, and the amount of available space left to the workers.
4. The division of employes by sexes.
5. The approximate number of employes over 40 years of age, between 20 and 40, under 20 years, and under 16 years. The reason for the 20-year division is that the adult does not usually attain his or her full stature and development before the 20th year. In very few shops were workers

Fig. 35. A Factory Rest Room.

This "sick bay" is maintained by a pottery company which employs a large number of girls.

under 16 years of age employed in any of the industries investigated. Here and there, especially during the summer seasons, children were found employed who acknowledged their ages as less than 14. Such instances, however, were very rare. Since there is a law under the administration of the State Industrial Commission governing the hours of employment for females, we did not check up this feature with any regularity.

6. A brief description of the process.
7. Were other processes in the same quarters, and, if so, the number of employes engaged in such. This is very important, since oftentimes one set of workers is subjected to the hazards of processes other than their own.
8. Were modern or crude methods used. Such were judged by using as a criterion the better known hygienic methods, but "crude" or "antiquated" methods is a term which was only applied to such places as were particularly endangering the health of employes when much better methods of accomplishing the same purposes were found to exist elsewhere.
9. The presence or absence of unions or workmen's organizations.

FIG. 36. THE EMPLOYER'S INTEREST IN THE WELFARE OF EMPLOYES MAY WELL EXTEND BEYOND THE WORK PLACE.

Flying rings, and other equipment of a public playground, which is equipped and maintained by an industrial corporation.

10. The attitude toward the workers. This was determined by the presence or absence of welfare efforts, workers' complaints, and the immediate interest which foremen or managers appeared to take in the employe. As is well known, the best efforts of an employer towards his employes depends very largely upon the personality, tact and attitude of the foreman who is immediately over them.
11. The type of workers, whether intelligent, responsible, and capable of understanding instructions or whether an ignorant and usually non-English speaking class.
12. The retention of workers, or the steadiness which they evinced in remaining at the place of employment.

13. The number of work shifts in 24 hours, the hours per shift, night work, overtime, noon time, and other recesses.
14. The approximate number of skilled and unskilled at the process.
15. The seasonal influence of the work, whether rush seasons and dull seasons characterize it.
16. The presence or absence of health appliances, that is, mechanical devices to promote ventilation and confine or remove fumes, dusts, etc., from the vicinity of the workers.
17. Health instructions, regarding the use of poisons and the avoidance of other health hazards which might be present. An attempt was made to ascertain how much attention was given to this by employers and foremen, and how well they were qualified in this field, which in most instances requires a thoughtful physician.
18. The presence or absence of health placards, inspiring aphorisms, legends, etc.
19. The presence or absence of a proper or safe place in which to eat lunches.
20. The presence or absence of change rooms and lockers for clothing.
21. Sanitary provisions, including washing facilities, drinking facilities, and whether time was allowed for personal hygiene along these lines, particularly in poisonous, heat exposing, or dirty processes.

Below is a fac-simile of the card used by our field investigators to report working conditions and health-hazards to the office. A simple code enabled each feature mentioned to be designated "good," "fair," "bad," or "absent," while the blank spaces permitted of brief remarks.

DEPARTMENT REPORT

OHIO STATE BOARD OF HEALTH

Survey of Occupational Diseases.

City .... Date ....

Establishment ....

Department .... Location .... Good? ....

Intended for .... Health of workers considered in construction ....

Chief process .... Males........ Females........ Youths........ Minors........

Character of work ....

(Other processes .... No. Employés..........)

Modern methods? .... No. work shifts for 24 hours ....

.... Hrs. per shift.......... Night.......... Overtime..........

Unions .... Noon time.............Other recesses....................

Attitude toward workers .... No. skilled.......... Unskilled....................

Type of workers .... No. by age-groups....................

Retention of workers .... Seasonal influence ....

Health appliances ....

Health instructions .... Health placards ....

Lockers .... Change rooms................ Lunch rooms................

Toilets .... Washing.......... Showers.......... Time allowed..........

(OVER)

INDUSTRIAL HEALTH HAZARDS.

1. DUST from process: type........................ breathed.,.............. skin................ eyes................ control..............................
2. DISORDER: workplace............ neighborhood.,............ homes............ DIRT: from process............ from negligence..................
   Floor: type............ cleaning: O. K.: dry, wet, oil, during work hours?............ frequency..
3. DAMPNESS: water............ steam............ humidity............ dryness..
4. DARKNESS: during day............ reason............ artificial lighting: AEGO by the process............ efficiency..............................
   Injuries from contrasts, shadows, glarc, ought colored glasses be worn?............ Are they?..
5. IMPURE AIR: stillness, free flames without vents, salamanders, fumes, vapors, gases..
   Ventilation: of quarters............ of processes............ methods..
6. HEAT: process exposure............ degree............ protection: mechanical...
   Personal (rest intervals, washing facilities, shower bath)..
7. COLD due to: process, heating method............, inefficient heating, drafts, sedentary work, alternation with heat..........................
8. FATIGUE: laborious work, long hours, piece-work, speeding up, monotony, constant standing, constant strain, chairs without backs..............
   Faulty postures............ jarring processes............ body pressure............ eye strain............ loud noises..............................
   Rest rooms, work variations, rest periods, recreation schemes...
9. INACTIVITY: provisions for exercise............ for recreation............10. CAISSON WORK: air locks...................................
11. INFECTIONS: crowding (irrespective of room space), common towels, cups, wash places, closets, spitting on floors, absence of cuspidors
    ....
    Infectious materials, mouthed articles, wiping rags, oil, frequent trivial injuries, calluses, flying particles.................................
    Selected workers, physical exams., medical supervision, goggles, gloves, first aid and hospital arrangements...................................
12. POISONS: kind and form.. sample taken.......................... Am't. of risk.........................
    Workers ignorant, misbranding, lack of instructions, disregard of instructions, wrongful instructions, harmful regulations, moustaches, beards, eating at work or in work rooms, personal care, efficient medical supervision, gloves, respirators, clothes, lockers, washing facilities, eating places, water closets, MECHANICAL PROTECTION..
13. ALCOHOLISM: drinking water "good", properly cooled, plentiful; liquors permitted during work; subjection to dust, bad air, fumes, gases, vapors, heat, cold, dampness and poisons; saloons near, employer mindful, home gardens, workers' efficiency department.............................
14. VENEREAL DISEASES: common handling of articles, sexes working together, immoral atmosphere...
15. APPEARANCE OF WORKERS.................................

Signed ....

In the summaries which follow it will be found that the same terms and expressions have been used again and again. If value of repetition means anything, it is hoped that these repetitions will effect their purpose, and, where indicated, bring about the remedial measures necessary.

Some facts stand out: Owners and managers of plants hygienically well-regulated and who have been giving attention to the same for years, perhaps, often refuse to believe that conditions dangerous to the health exist in other plants engaged in the same lines as their own. Again, because owners and managers are not hygienists nor physicians, they many times fail to correlate causes and effects and to have knowledge of or to see occupational complaints and diseases which are right before them. A solution of this situation, we repeat again, is that the employer have his own physician at hand, who, according to the risks involved, shall make periodic inquiries and render suggestions. There is no question, however, but that a considerable amount of intelligent thought has been directed to these matters in the majority of the places investigated.

The processes summarized in the following pages have been divided into two groups: *General Processes* and *Special Processes*. The former are those which are apt to be found in any industry or establishments; the latter, those which are peculiar to certain industries.

GENERAL PROCESSES

GENERAL PROCESSES.

FACTORY PROCESSES (GENERAL).

A large percentage of employes in shops and factories are employed in numerous operations, which, while more or less peculiar to each industry, are very similar in nature. Such operations do not require special skill or training, as a rule, although experience develops great dexterity and speed in many instances. The workers are capable of being interchanged between various operations. Especially do they change from one establishment to another, and usually take up new operations with each change. Such workers constitute a class slightly in advance of common laborers, and we have classed them as "general factory help". In a rough way they may be grouped into certain processes such as "routine machine operations", "assembling", "inspecting", "finishing", "packing", and the like.

General factory processes were investigated in 100 plants, representing 35 different industries, located in 18 cities, employing a total of 7,946 wage-earners, of whom 5,045 were males and 2,901 were females.

According to the Vital Statistics Reports for Ohio for the years 1910, 1911 and 1912, there were 14,379 deaths among males engaged in Mechanical and Manufacturing Pursuits, of which number 1,977 died of pulmonary tuberculosis, or 13.7%. This is about the same as the rate for all occupations combined (13.3%). The figures for females were too few to be utilized, but indicated, so far as they went, a much higher tuberculosis rate (45.8%). According to the U. S. Mortality Statistics for the Registration Area, pulmonary tuberculosis claims 27.4% of the deaths among females engaged in Mechanical and Manufacturing Pursuits, the rate for males being 15.5%.

So far as could be ascertained, modern methods obtained in 81 establishments investigated, fairly so in 10 more, not so in 4, while the remaining 5 were not reported upon in this respect. Unions, of course, were rare among this class of workers, although in 4 plants these workers were admitted into various "locals" because they were helpers and the like. A managerial interest in workers' welfare was well manifested in 72 places, fairly so in 20 more, not so in 4, and not reported upon in 4. An intelligent type of at least English speaking persons prevailed in 67 places, fairly so in 19 more, while ignorant foreigners, largely non-English speaking, made up the general factory workers in 13 places (the 1 remaining place was not reported upon). There appeared to be no objection to the character of the work performed on the part of the workers, and accordingly they remained steadily as far as this feature was influential in 79 places, fairly so in 9 others, while in 9 more working conditions appeared to be the chief cause of unsteadiness of employment (3 places were not reported upon). In 18 places every reasonable health appliance was found to be present, including appliances for changing the air in the workrom where needed, as well as locally ventilating, or otherwise rendering hygienic, the processes in which the workers were engaged. Such appliances were fairly efficient in 6 more establishments, but in the remaining 76, in most of which there was need of the same, they were either absent or very inadequate. Definite and oganized instructions along health lines, especially in rela-

tion to the work being performed, were given in 8 of the plants investigated, and to some extent in 2 others. Such were more or less needed in the remaining 90. In 8 establishments this class of workers was included in sick benefit and similar associations. Regarding the question of skill, in 15 processes in as many places, considerable skill was required, while those in 25 additional places were somewhat skilled. In the remaining 60, such factory processes could be carried on with very little interruption to business or production with a constantly changing work force. Factory workers were employed in hygienically well constructed buildings and workrooms in 51 places, fairly so in 16 more, not so in 29, while this feature was not reported upon in the remaining 4. There was a great tendency to carry on various factory processes in the same quarters or room, and oftentimes along with processes requiring skilled work, so that oftentimes workers were subjected to the hazards of neighboring processes, when, perhaps, those in which they themselves were engaged were without hazard to health.

Age-group estimations for this class of workers summed up as follows:

Age groups.	*No. of Wage-earners.*
Over 50 years	113
From 45 to 50	171
From 40 to 45	550
From 20 to 40	6,900
Under 20 years	212

Females tended very largely to younger years.

A synopsis of the exposures to the various health-hazards, arranged in relation to the number of workplaces, shows as follows:

Health Hazard.	Amount of Exposure (No. of Workplaces.) None.	Fair.	Bad.	Not Reported.	Total Workplaces.
Dust	63	20	16	1	100
Dirt	49	30	21	......	100
Dampness	89	10	1	......	100
Darkness	76	14	10	......	100
Air	44	38	18	......	100
Heat	77	19	4	......	100
Cold	93	5	2	......	100
Fatigue	(See Below)				
Inactivity	(See Below)				
Infections	15	42	41	2	100
Poisons	66	15	19	......	100
Stimulantism	25	56	19	......	100
Several unhealthy appearing persons	53	37	5	5	100

Fatigue was a hazard as follows: hurrying piece-work, 41; monotonous application and reduplication of movements, 37; constant standing (still), 25

(sometimes holes worn in the floor almost the shape of feet); eye-strain, 16; prolonged faulty postures, 15; jarring processes, 13; loud noises, 12; speeding up, 11; laborious work, 9; long hours, 8; chairs without back rests, 8; constant and prolonged strain, 6; and body pressure (pressing objects against body, or the body against objects, more or less constantly), 5. In 13 establishments there were rest rooms for female help, in 14 establishments workers were changed between processes, thus avoiding exhaustion, while in a smaller number of instances, various recreation schemes combined with outdoor and gymnasium privileges were devised. To overcome the effects of physical *inactivity*, provisions for exercise or recreation were arranged for in 4 establishments. Much profitable thought could have been given to this in a good percentage of other places. In these 100 establishments the *workday* was found to be 8 hours in 4

FIG. 37. MODEL FACTORY CONDITIONS.

Note chairs with backs and foot rests for sedentary workers. Spacious and well-lighted room.

places, 8 to 9 hours in 37 places, 9 to 10 hours in 49 places, 10 to 11 hours in 2 places, over 11 hours in 1 place, and not ascertained in the remaining 7, in some of which there were no definite hours observed. The *noon recess* was 1 hour in 32 places, ¾ hour in 9 places, ½ hour in 58 places, and not reported upon in 1. Overtime was of considerable frequency in 3 places, while a night shift was worked in 1.

The liability to the contraction of *communicable diseases* (infections) was determined as negligible in 15 places, a fair hazard in 42, bad in 41, the remaining 2 not being reported upon. The hazards were all of those discussed in previous Parts (II. and III.), but especially would we call attention here to promiscuous spitting upon floors in workplaces by persons who are employed without physical examination and who work without medical supervision. This

single factor is overwhelmingly important in the the spread of some 20 infectious and contagious diseases, which involve the nose, throat and lungs, and the germs of which are transferred from person to person by means of the excrement from these parts. The universal use of cuspidors where persons are employed for hours at a time in which to deposit such excrements seems the first logical step in the solution of this question. The association of *appendicitis* with work requiring the use of the right foot or leg, as among machine operators and press workers, was well illustrated by a series of four cases brought to our attention among girls in a shoe factory where they were employed at box-making on machines. They made from 8,000 to 12,000 movements with the right foot daily. The work was also very jarring and wearing upon them. One had acute appendicitis, one chronic appendicitis (possibly complicated with ovaritis), while the other two had continually recurring attacks of right iliac pain with indigestion.

The *poison* hazards to which general factory workers were exposed in the 35 places shown in the table were lead and lead compounds, wood alcohol, turpentine, benzine (petrol, naphtha, gasoline), corrosive salts, amyl acetate, shellacs, lacquers, acids, alkalis, dye stuffs, stains and colors.

The industrial inducement to *stimulantism* (alcoholism, coffeeism, teaism and drugism) was determined as negligible in 25 instances, a fair hazard in 56, and bad in 19. It was due in many instances to the inadequacy of proper drinking water and thirst-assuaging facilities, as well as to the depressing influences of the various hazards given in the table above.

Complaints, covering all manner of health-hazards, insanitary working conditions, and irritating inconveniences, which workers made were too various and numerous, and sometimes trivial to warrant discussing here, but it suffices to say that our investigators, who occasionally stopped to talk with these workers in the course of their factory inspections, reported among them 11 occupationally diseased persons, divided as follows: industrial tuberculosis, 6; lead poisoning, 3; conjunctivitis, 1; and dermatitis, 1; while there were a great many hearsay instances, based upon good evidence, — the hazards were certainly present, — which our investigators had not the time to follow up. Hospitals, dispensaries, charitable institutions, societies and private physicians get the information upon these, but practically none of them keep records and files classing "occupational complaints," hence this source of information was not available to this survey.

Comments. — This class of workers represents such a large group that it should be given more thought, probably, than any of the special processes, to which attention is naturally more definitely directed. However, these workers are prone to get the least attention because of the ever-changing personnel, and lack of skill, and, unlike machinery, each unit which proves defective can be replaced without cost to the manufacturer as long as the supply of labor remains good. It is pre-eminently from this class of workers that the material for crowding hospitals, dispensaries and charitable institutions is collected; it is also from this class of workers that the vast majority of unemployable persons develop. Such persons are rendered unemployable usually fairly early in work life, — one reason for the comparatively small number who are found engaged in industry after 40 years of age. This unemployability is the result, chiefly, of such factors as chronic alcoholism, maiming and crippling, chronic diseases of degenerative character, and social

disgust or loss of ambition. In all of these, industrial relations unquestionably have been the chief causes. Probably the greatest good that can be done for this class of workers to keep them "on the job," from a manufacturer's point of view, is to institute brief but concrete instruction along health conservation lines in conjunction with work. Medical supervision should be gradually adopted. The employer is further responsible, of course, for the general sanitary and hygienic features of his place of employment, as well as his methods of working his employes. Moral and housing hazards among employes are so closely associated with industrial relation that it would appear that the employer is, of all persons, the most responsible, especially in that he can demand "his money value for his expenditure for labor," which gives him the right to normal healthy workers and the refusal of such as endanger themselves and their fellow workers by disastrous indulgences and social delinquencies.

GAS PRODUCING.

A comparatively few plants in the State of Ohio make their own producer or generator gas. This is made from coal in a combustion chamber, the fuel being burned to cinders. Illuminating gas is made in a few large cities in which coke is a by-product. Most of the blast furnaces utilize the gases produced for fuel purposes — a continuous mechanical process. The charging with coal and removal of clinkers was mechanically done in all except the smallest plants. The manufacture of special by-products, outside of coke and tar, was not observed anywhere. Ammonia liquor is also produced.

Our investigations covered 7 plants making producer gas and employing a total of 80 men. These were seen in connection with rolling mills, glass works, and lime kilns. In addition, the illuminating gas plants in 2 cities employing a total of 55 men were also seen. (In two plants 4 men were employed in the process of making water-gas.) The employes were nearly all immigrants, foreigners or negroes. Owing to the fact that they worked practically out-of-doors, — most of them engaged as pokers on top of the production furnaces — workers were very little protected by health appliances. The work required very little skill. With the exception of 1 man the workmen seen were all between 20 and 40 years of age. Workers did not remain long in most plants, especially in the summer season.

The *chief hazards* were to the persons who endured exposure to dust, soot, smoke, hot gas fumes and flames during the time that they were required to open the caps over the poke holes on top of the producer furnaces. This happened about every 10 to 15 minutes and lasted 2 or 3 minutes each time. At this time a severe blast poured forth from the opening, against which the workman who stood over the opening in order to break clinkers up, had no protection except to lean back as far as he could. The blast extended from 2 to 10 feet high, and consisted of flames and invisible gas, or was accompanied with immense volumes of smoke, soot and dust. Exposure to *heat* was a hazard for all workers, especially to coke drawers, but the alternating exposure to *cold* between operations during the winter season was a greater hazard. The stokers were usually high up in the air, with only a roof for protection against the weather. Coke wheelers were exposed to clouds of steam from the sprinkled coke. The work itself was not fatiguing for healthy laborers; the 12-hour workday, which obtained in nearly all places, with the

absence of a noon recess (a half-hour was allowed in two places), were objectionable features. One place found it expedient to work three 8-hour shifts. Night shifts, of course, were the rule. In small plants, 2 men divided the 24 hours, working 12 hours each. The risk of gas *poisoning* was a fair hazard in all places. It was influenced by the condition of the weather and wind, and especially by the persistency with which the pokers faced the blasts. Producer gas is over four times as rich (34%) in carbon monoxide gas as is illuminating gas (8%). There was every opportunity for the effect of chronic gas poisoning, due to short-intervalled inhalations of gas frequently repeated. Many of the workers were seen to stagger around for two or three minutes after each exposure. In water-gas manufacture there was some risk of carbon monoxide poisoning during sampling, and more, due to leaks; there was also slight risk, due to ammonia fumes, and napthalin which was deposited in clouds at the time of cleaning tanks. Several workers were seen who showed the effects of the work. One case of mental deterioration and another of spinal trouble and anemia were called to our attention, both following severe "gassing" in gas house workers. Two fatalities occurring in 1911 were also reported. *Complaints* included the breathing of gas and smoke, dizziness, "swelling up," the heat during hot weather, getting of foreign particles in the eyes, coughing, difficulty in breathing, indigestion, and rheumatism. The industrial inducement to *alcoholism* was, of course, considerable in most instances.

Comments. — One company furnished blue glasses, which protected the eyes against foreign particles as well as the heat and intense light. Through the spread of the "safety first" idea, greater precautions are being taken when it is necessary to enter gas chambers and passageways, such as providing oxygen apparatus, pulmotors and other first-aid equipments, in addition to gas helmets provided with compressed air blasts, and the careful watching of workers while so engaged. In 1 place a scheme was being worked out to prevent all exposure to the gases and flames as well as the loss of the same while poking, by means of a steam blast placed just inside of the poke hole, which would operate automatically on opening the cover to the same, and would also help in the moistening of the gas. These workers should be provided also with shower bath facilities and proper change-rooms, while medical supervision would prevent the employing of any who had a tuberculous tendency. It is said that even mechanical stokers and mechanical poking of the fuel in the producers is not free from exposure to escaping smoke and gases.

STATIONARY FIRING AND ENGINEERING.

(Boiler Rooms and Power Production.)

The power plants, including the boiler rooms, engine and dynamo quarters, were inspected in a large number of establishments. Only the boiler rooms appeared to present health-hazards worthy of notice. The workers here were firemen, coal heavers and laborers. *Dust, dirt*, ash and coal heaps scattered about, and a certain amount of contamination of the *atmosphere* with escaping gases and occasionally steam, were features in about half of the places. In addition, *damp* and *dark* quarters were frequently seen. In many large places automatic stokers did practically all the work, so that workmen were few and very little exposed, but *heat* was a considerable factor in many places. It was rendered worse by the tendency of the workmen to

step out-of-doors between stoking and shoveling to cool off. Another hazard is *fatigue,* which depends no so much upon hard work as upon long hours, especially for workers in hot processes. In practically no places were workers engaged for less than 10 hours, while usually two shifts divided the 24 hours between them. One day's rest in seven was least often observed in this process of any investigated. The liability to the contraction of *communicable diseases* was a considerable hazard in most boiler rooms, due, principally, to promiscuous spitting into places where the dust might carry infection to fellow workmen, to the absence of cuspidors, of adequate washing facilities, poor closets, and the common use of the same drinking cups and towels. In some places, however, all of these features were guarded against. The liability to industrial *alcoholism* in this process is directly in proportion to the inadequacy of proper thirst-assuaging facilities, and wash-up places, as well as too great exposure to heat, and subjection to long hours. Various ones of these factors were *complaints* in the places investigated.

Comments. — As with all heat exposed workers, these men should have the advantage of a properly protected shower bath, change rooms in which to dry out clothing, hours in inverse proportion to the amount of exposure, blue glasses to protect the eyes from heat, light and foreign bodies, and medical supervision to warn those who have a tuberculous tendency to keep out of the process.

According to the Ohio Vital Statistics Reports for the years 1910, 1911 and 1912 there were 649 deaths among Engineers and Firemen (not locomotive) of which number 66, or 10.17%, died of pulmonary tuberculosis. This is better than the combined rate (13.3%) for all trades during the same period, and nearly as low as that of Agriculturists (7.13%). The accident, injury and accidental poisoning rate among them for the country at large is 12.2%.

FURNACING.

In addition to the processes concerned in the boiler, power and firing rooms, in a great number of industries, a certain number of employes are engaged in taking care of furnaces, baking ovens, kilns, and drying rooms, which are located within the interior of buildings, and oftentimes in the midst of surrounding processes, such as in foundry work, heating furnaces for cutlery and tools, enameling and japanning ovens, and the like. None of these furnacing operations are on the scale of the large heating furnaces, annealing ovens, etc., which are found in iron and steel mills, and which are considered under that heading.

This process of Furnacing was investigated in 15 establishments, covering a wide range of products, and employing a total of 157 wageearners, all males. An unskilled class of workers was usually employed, there were no unions, and they were apt to be a changing set of employes. In 7 places health appliances consisting of means to prevent the effects of excessive heat were present, such as movable screens, asbestos coverings to furnaces, electric fans, air blasts, and various mechanical contrivances to permit the workers to keep at a distance from the openings of the furnaces. In addition, some places had a large hood, connected with a stack, over furnaces areas, as well as exhaust fans and air-agitators within the quarters to remove escaping fumes, smoke or odors. Too often open windows, or roof vents (always more or less closed up in the winter time) were the only means depended

upon for such ventilation. There was a tendency to employ youths and younger men at such work, while only 12 of the total of 157 workers were over 40 years of age.

The work was of a hazardous *dusty* character in 7 places, while *dirt* and disorder characterized the vicinity in 8 places. In 2 places the furnaces were located in very *damp* and steamy quarters, and, in 4, *light* was very poor. This occasionally was made much worse by the presence of smoke from the furnaces. In some instances, on the contrary, workers were compelled to face brilliant lights and intense heat, both tending to produce disturbances of sight (temporary blindness, blood shot eyes, corneal opacities, cataracts, and actual blindness from acute retinitis). The general room *ventilation* appeared good in 5 places, fair in 5, and bad in 5 (the latter due to deoxidation from the presence of the furnace in a closed-up room, contamination with the escape of gases from the furnace, pollution with dust, and sometimes smoke, steam and spray particles, stagnation from the absence of any means to promote circulation of the air, and greatly abnormal temperature-humidity relations). In the latter respect it was *extremely hot* in 3 places, where workers had to be, and more or less so in 8 more, while in but 1 or 2 instances were any shower baths at hand for the use of the furnacemen. In some 7 plants *fatigue* was a hazard, due to laborious work, and occasionally to piece-work. The workday ranged from 9 to 10 hours in all places, while in 10 places, only ½ hour was allowed for a noon recess. Other recesses depended upon the character of the work. The liability of contracting *communicable diseases* bore the same hazards as for other processes in the vicinity, but usually was great. There was also considerable hazard of chronic *poisoning* for most of this class of workers, the poisons extending over a large range, depending upon materials being baked or furnaced. The risk came usually from fumes and gases, but there were the additional hazards of poisonous dusts, and of handling poisons in many places. The opportunity for chronic gas poisoning from coal gases and unburned natural gas was good in numbers of places. The industrial inducement to *alcoholism* was quite pronounced in most places, and due to many factors (dust, heat, vitiated atmosphere, poisons, and the lack of opportunity for personal cleanliness).

The general *appearance* of these workers was usually below the average of those in surrounding processes, while in some places they complained bitterly of some one or another of the hazards above mentioned, all of which were usually plainly present. *Comments.*—The above delineation suggests the corrective measures necessary. In particular would we mention the installation of shower baths for all workers in such processes, both for physiological reasons as well as personal respect, while every effort should be made to keep the atmosphere which the workers are required to breathe, and to be otherwise subjected to, as nearly like that meant for their use by nature as possible. In no two places were hazards alike, so it is impossible to suggest specific improvements.

FORGING AND BLACKSMITHING.

This process is reported upon as investigated in 52 plants located in various parts of the State and in connection with the following industries: Agricultural Implements; Automobiles and Parts; Brass Manufacturing; Carriages, Wagons and Parts; Railroad Cars; Electrical Apparatus; Ship Build-

ing; Steel Manufacturing; Foundries and Machine Shop Products; Marble and Stone Cutting; Iron and Steel Products; Scales, Balances and Cash Registers; and Rubber Works. In a general way the process was about the same wherever investigated. In the 52 plants there were 1,608 wageearners, all males, engaged in forging and blacksmithing. The number of employes varied in different plants from 2 to 250. Methods appeared to be modern in 32 places, fairly so in 13 more, and not so in the remaining 7. There were no labor unions. The attitude toward employes appeared good in 41 places, fair in 9 more, and bad in 2 other (small) places. In 36 places the workers were of an intelligent type, while in the remaining 16 they were largely ignorant foreigners. Workmen appeared to remain well in 46 places, fairly so in 5 others, and not so in 1 place. Health appliances, consisting principally of hoods and stacks over furnaces and forges to remove fumes and smoke, were good in 24 places, fair in 2 others, and absent in the remaining 26. In 9 plants there were either placards or special instructions along health lines. In 7 plants the workers enjoyed the privileges of sick benefit associations. In 17 places (usually small) practically all the workers were skilled, in 6 more about half were, while in the remaining 29 the large majority were unskilled labor. Of the total number of workers 225 were over 40 years of age, 1,373 between 20 and 40, and 12 under 20. The general construction of the shop was good in 23 places, fair in 11 more, and poor in the remaining 18. In 14 places other processes were going on in the forging and blacksmith shop.

Dust was a negligible factor in 22 places, a fair hazard in 19, and bad in the remaining 11 places, the latter including some of the larger plants. It consisted chiefly of sand, metal, forge deposits and soot. Quarters were *clean* and orderly, considering the nature of the work, in 16 places, fairly so in 16 more, and not so in the remaining 20. Dry sweeping during work hours was frequently observed. Dirt floors existed in many places. *Dampness,* due to wet grinding processes, dirt floors, and poor location, was bad in 3 places, fairly so in 4 others, and no factor in the remaining 45. *Light* was bad in 8 places, only fair in 14 more, but good in the remaining 30. Artificial light was very poor in numbers of places. In others some workmen were constantly exposed to the effect of excessive light and heat upon the eyes without the use of dark goggles to protect them. The *ventilation* of the shops was good in 15 places, fair in 20 others, and bad in the remaining 17, due, principally, to the absence of hoods or other means of drawing off fumes from forges and furnaces, of good roof ventilation for smoke and fumes, and to gas yielding salamanders and heating stoves, and occasionally oil fumes. The exposure to *heat* was a fair hazard in 23 places, and bad in 7. The effects of *cold,* due to inefficient heating, drafts, and passing from hot places to cold places, was bad in 14 shops, and a fair hazard in 6 others. For the type of men who are employed in blacksmith shops, the work is not ordinarily particularly *fatiguing,* but in 10 places hurrying piecework was evident, while in about half this number laborious work, long hours, speeding up, constant standing in one place, steady strain, faulty postures, jarring processes, and constant pressure of objects against the body, were hazardous features. In all places loud noises were present, and in about 1/3 were reverberating and so excessive and frequent that workers were necessarily deafened thereby. The workday was found to be 8 hours in 5 places, 8½ to 9 hours in 4 places, 9½ to 10 hours in 40 places, and 10½ hours in 3 places. The noon recess was 1 hour in 14 places, ¾ hour in 8 places, and ½ hour in the remaining 30. The

liability to the contraction of *communicable diseases* was considerable in 30 places, fairly bad in 16 more, and negligible in the remaining 6, the chief hazards being spitting upon dusty floors, absence of cuspidors, common drinking cups, common towels, absence of inadequate washing facilities, improper closets, the lack of medical supervision (so as to keep out consumptive workmen especially), and the damaging influences of dust, dampness, fumes, heat, and cold, in places above mentioned. Further than this, overcrowding in some places, absence of first-aid equipment to prevent blood poisoning from trivial injuries, absence of hand pads or gloves, goggles, and the use of wiping rags from doubtful sources, were all noted. *Poisoning* by fumes or otherwise was a serious hazard in 23 plants, fairly so in 6 more, and negligible in the remaining 23. The chief danger was from chronic gassing, due to the escape of fuel fumes and smoke. In addition tempering and case hardening with lead, potassium cyanide and oil, were carried on in a number of blacksmith shops, (these processes are described elsewhere). The industrial inducement to *alcoholism* was considered negligible in 24 places, fairly so in 12 more, but considerable in the remaining 16, the principal features being inadequate drinking water facilities, and the exposure to the breathing of dust and fumes, and, in 7 places, of excessive heat without provisions to counteract its effects.

The general *appearance* of workmen was good in 28 plants, fair in 15 others, and bad in 4. (Reports on this were not returned in the case of 5 plants.) The chief *complaints* of the workmen were headaches, coughs, colds, rheumatism, and lumbago, which they charged to fumes and exposures; also excessive light, loud noises, in some places jarring processes, and in others the exposure to the hazards of other processes. A fairly common observation among workmen was impaired hearing. *Comments.*—The general effects of forging and blacksmithing are along the lines of wear and tear, with emphasis upon the breathing of contaminated air in a large number of places. Improvements should consist of impervious flooring instead of dirt floors, efficient hoods and exhausts over all furnaces, forges and grinding processes, cool air blasts and screens for workmen in hot positions, dark goggles for excessive light, cotton for the ears where noise is excessive, and, as in all hot processes, the providing of shower baths. The hazards mentioned above indicate further corrections.

According to the Ohio Vital Statistics Reports, there were 986 deaths among blacksmiths for the years 1910, 1911 and 1912, of which number 77 died of pulmonary tuberculosis, or 7.91%. This compares very favorably with the death rate from the same cause for all occupations in the State combined (13.3%), and even with agriculturists (7.13%). However, the vast majority of blacksmiths are in small, open and naturally well ventilated shops, rather than the large plants such as our investigators covered. According to the U. S. Census, 13.8% of blacksmiths died of heart disease, 11.4 of pulmonary tuberculosis, 10% of apoplexy, 9.7% of Bright's disease, and 8% of pneumonia.

COREMAKING.

This foundry process is too well known to require description here. It was investigated in the following lines of industry: Brass Founding, Iron Founding, Iron and Steel mills, Agricultural Implements, Automobiles, Electrical Apparatus, Stoves and Safes, and several Machinery Manufacturing

firms. Our reports are based upon investigations made in 31 plants. There were a total of 989 employed at the process, of whom 861 were males and 128 were females, the latter in 6 different plants. Union organizations existed in 2 places. An intelligent type of workers was employed in 2 places, fairly so in 9 more, and, in the remaining, the employes were largely ignorant foreigners. An excellent welfare attitude toward employes existed in 24 places, fairly so in 2 others and not so in the remaining 5. The workers in 27 places appeared to remain well at the process, fairly so at 3 places, and not so in 1. Health appliances, consisting of hooded drying ovens, workroom ventilating apparatus, goggles and respirators (the latter where needed), were good in 3 places, fair in 5, and absent in the remaining. In 6 places the employes had privileges of sick benefit and pension associations. The most of the workers were skilled in 18 places and unskilled in the remaining 13 (this feature depended chiefly upon differences in process). Workrooms were hygienically constructed in 16 places, fairly so in 8, and not so in the remaining 7. The work was done in the foundry room in 18 places (in none of which were females, although some were in places only partly partitioned off from the foundry atmosphere). On the other hand the core drying ovens were nearly always in the coremaking workroom.

Dust, consisting of sand, earths and mold powders, was a bad feature in 5 places, fairly so in 5 more, and negligible in the remaining 21. Quarters were *cleanly* in 20 places, fairly so in 4 others, and not so in the remaining 7. *Dampness,* due to the nature of the work and poor location, was a bad feature in 3 places. *Light* was bad in 4 places, only fair in 2 others, and good in the remaining 25. The general *aeration* of quarters was good in 14 places, fair in 14, and bad in the remaining 3, the factors being fumes and smoke, either from the foundry or escaping from the drying ovens. *Heat* was no factor in 22 places, was a fair hazard in 6 and bad in 3 places, due to proximity of core ovens which were improperly shielded and ventilated. On this account workers were often subjected to the effects of alternation between heat and cold drafts. *Fatigue* was a considerable hazard in 18 places, fairly so in 11 more and negligible in 2, due principally to hurrying piecework, monotony, constant standing, and less often to such features as laborious work, prolonged faulty postures, and loud noises. The workday was 8 hours in 2 places and from 9 to 10 1/6 hours in all but 1 place, where it was 11 hours. The noon recess was 1 hour in 2 places, ¾ hour in 3 places, and ½ hour in the remaining 26. The risk of contracting *communicable diseases* was negligible in 4 places, fairly so in 21 others, and bad in the remaining 6, due principally to inadequate washing facilities, poor toilets, promiscuous spitting, absence of cuspidors, use of common cups, and occasionally to overcrowding. Physical examination of workers was practically unheard of, although first-aid provisions were good in the majority of places. For a more or less dirty class of work such as this is, it is questionable from a health point of view whether sexes should be permitted to work together. The liability to occupational *poisoning* was negligible in 11 places, a fair hazard in 11 others, and considerable in the remaining 9, due to escaping gas fumes and smoke, principally from core ovens, and the breathing of brass fumes in many brass foundries where frequent pouring was done, and the coremaking was done in the same quarters. The inducement to *stimulants* was bad in 11 places, and considerable in 15 more, due to the lack of adequate drinking water facilities, places other

than the work rooms and saloons in which to eat, and to the depressing influences above mentioned.

The general *appearance* of workers was good in 25 establishments, a goodly number were below par in 5 others, and especially were they so in the remaining place. The chief *complaints* of workers were the breathing of burned gas fumes and smoke which escaped from baking ovens, causing headache, nausea, and general ill health, also odors from inside toilets which were improperly ventilated. *Comments.* — Corrective measures consist in separating this process from the general foundry, providing seats with backs, and the proper ventilation or separate location of the drying ovens, to which must be added features of general sanitation. Less than 1/6 of the places were above criticism for hygienic, airy, light and sanitary quarters.

IRON FOUNDING.

Iron founding includes, properly, the melting of iron and pouring it into molds, which have been previously prepared by the molders and their helpers, and the subsequent opening of the molds, freeing the castings from mold dirt, and cutting off the "gates" from the castings. In the iron foundry the molders are the skilled workers, the firemen and furnacemen (see Furnacing), semi-skilled, while a considerable percentage of unskilled labor is employed as helpers.

Iron founding was investigated in 43 establishments, in 14 cities, employing a total of 4,721 wageearners, all males. The process was investigated in 11 industries, arranged in descending order as follows: Foundry and Machine Shop Products, 15; Iron and Steel Mills, 7; Stoves and Furnaces, [illegible] Agricultural Implements, 5; Automobiles and Parts, 2; Musical Instruments, 2; Brass and Bronze Products, 2; and one each of the following: Enameling and Japanning, Electrical Apparatus, Safes and Vaults; and Iron and Steel Forgings.

The Mortality Statistics among Molders, according to the Ohio Vital Statistics Reports have been discussed in Part IV, under the heading of Foundry and Machine Shop Products (*q. v.*). — According to the figures submitted by the Financier of the International Molders' Union of North America, the Ohio branch of the Molders' Union suffered 204 deaths during the five-year period from 1909 to 1913 for which death benefits were paid (there were 87 additional deaths not coming under the benefit privilege), the chief causes of death being, in order, pneumonia, 30; heart trouble, 30; tuberculosis, 27; and violence, 18. The Sick Fund of the same organization presents, also, through its Financier, the following statements and figures for Ohio, for the year 1913:

"The following list gives the ailments, the number of members receiving benefits, the number of weeks' benefits receivd under each heading and its percentage to the total number of weeks' benefits paid during the year (1913):

	No. Members (Ohio) Paid.	No. Weeks (Ohio) Received.	Percentage of Benefits Paid.
1. Throat and Lungs.........	262	620	16.7
2. Rheumatism	207	580	15.6
3. Accidents	255	613	16.5
4. Burns	132	286	7.7
5. Heart, Kidney, Liver, Bladder	56	137	3.7
6. Lumbago, Sciatica, Neuritis..	107	231	6.2
7. Intestines and Rectum.......	59	185	5.0
8. Stomach	81	200	5.4
9. Tuberculosis	12	41	1.1
10. Miscellaneous	313	821	22.1
Totals	1,484	3,714	100.0

"With but few exceptions in the months of January, February and March of each year the amount of Sick Fund collected has been exceeded by the sick benefits paid out. The only explanation for the large outlay that characterizes the first quarter of each year is the severity of the weather that particularly affects those who are subjected to the heat of the foundry during cast time, combined with the poor facilities that obtain in so many places for keeping the shops warm during the daytime.

"We can well understand that foundry conditions are such as to promote the prevalence of both throat and lung disorders, and also rheumatism. The violent changes in temperature, the drafts and dampness of the foundry, are conducive to suffering of this kind. It might truly be said that rheumatism in its several forms appears to be the nearest approach, if any, to what might be designated as an 'occupational disease.' We are not making this as a positive statement, but rather as a deduction from our records of 1913."

The places which our investigators inspected were non-union in 30 instances, union in 10 others, while this was not reported upon in the remaining 3. The employers' interest in the workers' welfare appeared good in 31 places, and at least fair in 8 more. The general type of workers was good in 24 places, fair in 8 more, but largely ignorant foreigners in 9 others. The majority of the workers appeared to remain steadily at the process in 37 places, fairly so in 2 others, and not so in 3. Especially devised health appliances, such as hoods and exhausts over furnaces, and exhausts and air conditioning systems for the foundry quarters, were good in 6 places, fair in 4 more, poor in 1, and absent in 31. Instructions concerning the conservation of health were given in an organized way in 4 places, and to some extent in 4 more. In 6 of the places investigated benefit associations existed among the employes (these do not include the benefits provided by the Molders' Union). Foundries were hygienically well constructed in 15 places, fairly so in 10 more, not so in 14, and not reported upon in the remaining 4. Other processes than Iron Founding were carried on in the same quarters in 19 of the plants visited. These consisted of Core-Making, Pattern Making (Wood-working), Metal Grinding, Brass Founding, Tempering, Machine Shopping and various others. The age-group estimations summed up as follows:

Age Groups.	*No. of Iron Founders*
Over 45 years	149
Between 40 to 45	386
Between 20 to 40	4,082
Under 20	15
Not ascertained	89
Total	4,721

The presence of foundry *dust* appeared a negligible hazard in 7 places, fairly so in 17 more, and bad in the remaining 19. This dust was composed chiefly of mold sand, iron oxides, iron, dross, slag, cinders and dirt. Of these the first is to be considered the most harmful. While it is practically impossible to avoid dust in iron foundries, the presence of sub-processes, such as Casting Cleaning, and Furnacing, as well as other processes (mentioned above), which might be carried on in separate quarters, add greatly to the amount of fine dust floating in the air. A foundry is also a difficult place to keep *clean* and *orderly,* but in 10 places quarters were found exemplary, while, in the remaining 33, heaps of mold sand, slag, cinders, castings and patterns were allowed to accumulate more or less promiscuously, while little attempt was made to clean up quarters, windows, skylights, etc. Dirt floors were found to exist in about one-third of the places, while, on the other hand, in about the same number the work was done upon concrete floors. *Dampness* was a bad hazard in 5 foundries, fairly so in 5 more, due to the wetting down of the earths used, careless cleaning of castings, wet grinding, and the absence of floor drains, as well as the difficulty of drying out earth floors within a building. Natural *light* was good in a total of 30 plants, fair in 7 more, and bad in the remaining 6. A great many plants were supplied with eye-damaging, expensive and inefficient artificial lighting by naked electric lamps (without reflectors or other illuminating enhancements). The *air* content appeared good and capable of being kept fairly free of contaminating gases and smoke in 13 places, to a less extent in 17 more, while it was bad throughout most of the day in 11 more. The usual contaminations were mold fumes, gas fumes, smoke, dust, and steam, while in a number of places the air was badly vitiated during the winter seasons by the presence of coke-burning salamanders used for heating, placed about in the quarters, and yielding immense amounts of invisible coke gas due to the absence of flue connections to the outside. While there is a necessary exposure to *heat* in the foundry process, it was usually short-intervaled, and a negligible hazard to the workers so employed in 20 plants, fairly so in 15 more, but bad in 7. In a number of places it could have been greatly lessened by protective devices, more room for its diffusion, ventilating fans, air blasts, and the like. On the other hand, *cold,* due either to the absence of inefficient heating, or the rush of cool drafts through areaways, was considered a hazard to many workers, in at least 15 places. This was so, particularly, for workers about the outskirts of the quarters who were standing before benches the greater part of the day. It is but natural that chilling of certain muscles and groups of muscles, which at intervals must be called into sudden severe straining actions, usually in hot places, should be greatly affected with sprains and rheumatism, shown as lumbago, wry neck, sciatica, neuritis, severe chest and shoulder pains, stiffness of joints, etc. Particularly

is this condition favored by the going out-of-doors to closets, or at noontimes, or going home while wearing sweaty underclothes. Foundry work cannot be considered unduly *fatiguing* to the average normal adult, but it may be made so by such factors as the following, which were found to be present to the extent mentioned: hurrying piece-work, 22; speeding up, 8; overly laborious work, 7; monotony, 9; long hours at the manipulations concerned, 7; jarring processes (pneumatic tampers), 5; prolonged strain, 2; constant standing in stooped and awkward positions, practically all. The workday was 8 hours in 2 places, 8 to 9 hours in 12 places, 9 to 10 hours in 19 places, 11 hours in 1 place, and 12 hours in 1 place. The noon recess was 1 hour in 9 places, ¾ hour in 6 places, and ½ hour in 27. Overtime was quite unusual. The liability to the contraction of *communicable diseases* was a considerable risk in all except possibly 6 places. The chief reasons were promiscuous spitting into places in which the dust was being continually "kicked up," the absence of cuspidors, and, somewhat less often, to poor washing facilities and closets, as well as crowding together of workers. In a very few plants medical supervision protected against the presence of the consumptive worker and in all such first-aid equipment and hospital arrangements were excellent. There was not much liability to *poisoning,* outside of the intervalled breathing of certain amounts of gas, as far as iron founding itself was concerned, but in a number of places brass chills, from the escape of brass fumes, and tempering, or case hardening with lead and potassium cyanid were a hazard to the founders as well as to the special process workers. The relationship of industrial *alcoholism* to iron founding may be stated as directly in proportion to the subjection to the hazards named, especially fumes, smoke and dust, absence of proper washing facilities, and inadequate thirst-assuaging provisions. Furthermore, in numbers of places foundrymen ate their lunches largely in saloons, unquestionably as much from a desire to get out of the foundry air as for any other reason.

The general *appearance* of the average of foundrymen was considered good in 18 places, fair in 12, and much below par in 8 (the remaining 5 not being reported upon). The chief *complaints* of foundrymen were the inefficiency of ventilating arrangements, which necessitated the breathing of gases and smoke, particularly in the winter time, the absence of local exhaust systems to handle slag dust, dust and noises from other processes, and shortcomings in sanitary arrangements. Of specific *occupational diseases,* our investigators observed 2 cases of lead poisoning, due to lead tempering in the foundry quarters. The effects of great heat upon the face and skin were commonly noted. There were lots of *complaints* of bronchitis, rheumatism, diarrheal attacks and cramps in warm weather (the last two usually laid to drinking cold water, but recognized as due to poisons generated within the system by over-heating and fatigue), inefficient winter heating, poor or distantly located closets, and other questions under general hygiene.

Comments.— Probably the greatest single need in foundries is "back stop" cuspidors and warnings to keep sputum confined so as not to contaminate the dust in the atmosphere. Next, and equally as important, the presence of a shower bath with instructions upon its physiological purport. Next we would mention the doing away with dirt floors as soon as possible, and the presence of other poisonous or hazardous processes. The subject of drinking water is a most important one, and attention should be given to bubbling fountain supplies conveniently located, and the water supplied at a proper temperature, neither too warm nor too cold. This was done in some places. In certain

processes men should wear dark goggles to protect the eyes from excessive heat, as well as light, while there should always be respirators available to be worn temporarily for unavoidably dusty manipulations. Hand protectors should be provided for handling hot scrap and iron. As there is some danger from "gassing" in all foundries, first-aid equipment should include a resuscitation apparatus as well as a tank of oxygen. Founding is an example of an industry which in itself should be harmless, in fact, should promote health and longevity the same as any application requiring the general use of nearly all of the body functions. It is rendered dangerous chiefly because it is done indoors. On this account a great many precautions are necessary to be taken, as indicated, including the general medical supervision of the workers.

PNEUMATIC TAMPERS are veritable engines of destruction to the human

FIG. 38. CLEANING METAL CASTINGS.

An unavoidably dusty and gaseous work. Note exhaust pipe beneath table, which has openings into table top. Also respirators are necessary. Gloves furnished.

nervous system, and mechanisms should be introduced to take the jar off the worker as well as instructions in the proper physiologic use of the same.

CASTING CLEANING is necessarily very dusty as usually performed and whether done by hand with steel brushes, or with sand and air blasts, or by knocking and tapping, laborers so engaged should be protected from the dust, probably best by helmets supplied with compressed air blasts. *Tumbling* of small pieces or cleaning within cabinets, or other dust confining means should be used where possible.

BRASS FOUNDING.

Brass Founding is very similar in methods of procedure to Iron Founding, except that a number of small melting furnaces are commonly used. These

may be sunk beneath the floor level and crucibles placed within them to hold the metal or small steel furnaces mechanically handled and furnished with a strong blast may be used. There are many other types of furnaces. The castings made are as a general rule much smaller than those turned out in iron foundries, and in much greater variety of shapes. In the brass foundry practically all non-ferrous metals may be melted down, but the commoner ones are zinc, copper, lead, aluminum, bismuth, tin and antimony, as well as some phosphorus, nickel, manganese. In this connection we have included in Brass Founding all processes requiring the melting down and pouring into molds of non-ferrous metals, with the exception of some printing and engraving special machine processes.

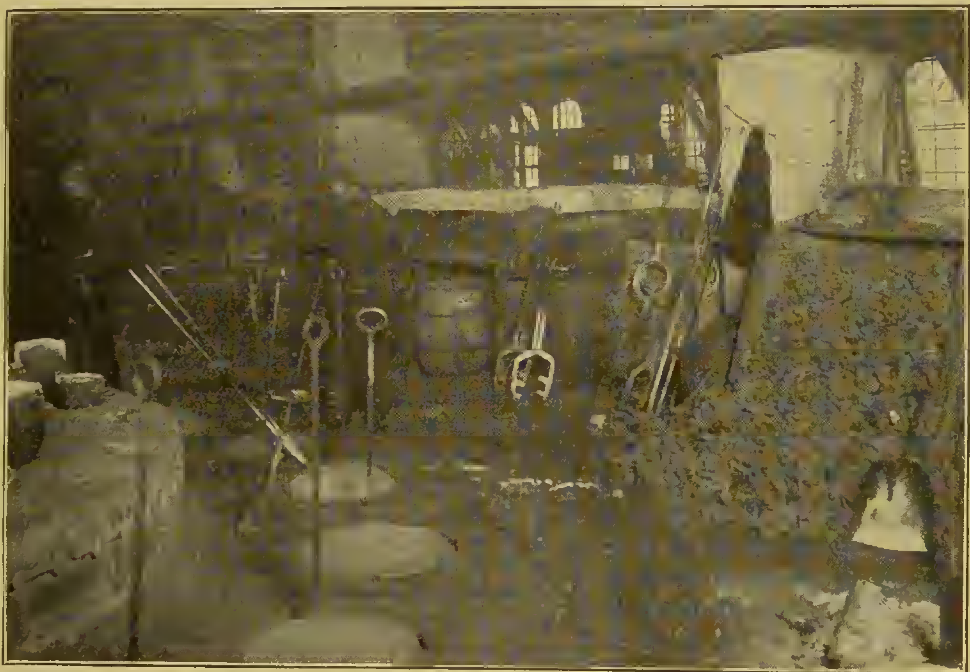

Fig. 39. Brass Foundry.

Each furnace (in the floor) is covered with an iron lid. The furnaces form a circle around the flue or chimney, the base of which is shown on the left. Note the pipe above from which fresh air is blown upon furnacemen when opening furnace tops.

Our investigations covered 106 establishments, located in 8 cities, and employing 2,148 wage-earners, all males. Non-ferrous metal melting was investigated in connection with the following industries, arranged in descending order: Brass and Bronze Products, 54; Electrical Apparatus, 10; Stereo- and Electrotyping, 5; Iron Founding and Machine Shop Products, 5; Smelting and Refining, 4; Lead Bar, Pipe and Sheets, 3; Coffin Fixtures, 3; Automobiles and Parts, 3; Iron and Steel Mills (brass foundries), 2; Printing and Publishing, 2; Cutlery and Tools, 2; Junk, 2; Cash Registers, 2; Paint and Varnish Manufacturing, 2; Flags and Regalia, 1; Stencils, 1; Musical Instruments, 1; Railroad Cars, 1; Street Cars, 1; and Rubber Manufacture, 1.

Vital statistics unfortunately do not distinguish between Iron Molders and Brass Molders, as a rule. (Attention is called to the statistics given in Part IV under "Foundry and Machine Shop Products," and to "Brass and Bronze Products;" also to "Iron Founding," Part V.) We call attention to the relative rates given in the U. S. Mortality Statistics for pulmonary tuberculosis as occurring among Iron and Steel Workers and Brass Workers. In the former it is the cause of 16.3 deaths out of every 100, and in the latter 31.3 deaths in every 100.

The plants investigated employed from 1 to 275, a large majority ranging from 3 to 20. The molders belonged to unions in 6 of the plants. The general attitude toward employes seemed good in 50, fair in 21, and quite bereft of personal interest in the remaining 35, usually smaller places and engaged in some of the odd lines mentioned. The class of workers was good and very largely skilled in 65 places, fairly so in 29 more, and not so in the remaining 12. In 25 of the places investigated the workers were only of short tenure, and not much better in 14 more. In 16 places exhaust hoods and vents were found over furnace areas, while in 25 more various arrangements to improve the atmosphere, such as air blasts and exhaust fans, were present. In no place were means adopted to confine and remove brass fumes during pouring. In 8 places instructions concerning the conservation of health were given in an organized way, and some attention was given to this in 6 more, but comparatively nothing in the remaining 92. Brass foundrymen were privileged to join sick benefit organizations in 10 establishments. The general construction of brass foundries was determined as hygienically good in 42 places, fairly so in 21 more, and not so in the remaining 43. In 29 places other processes than those concerned with brass founding were being carried on, chiefly, Coremaking, Metal Grinding, Casting Cleaning, Machine Shopping, Polishing and Buffing, Assembling and Finishing Processes (see Factory Processes). Age-group estimations summed up as follows:

Age Groups.	*No. of Soft Metal Founders.*
Over 50 years	40
45 to 50 years	120
40 to 45 years	296
20 to 40 years	1,670
Under 20 years	22

The general hazards of *dust, dirt, dampness, darkness, heat, cold, fatigue* and *infections* did not differ materially from those already described under Iron Founding. The workday was found to be 8 hours in 5 place, 8 to 9 hours in 42 places, 9 to 10 hours in 58 places, and between 10 and 11 hours in 1 place. The noon recess was 1 hour in 13 places, ¾ hour in 14 places, ½ hour in 76 places, and not strictly observed in the remaining 3. A morning lunch interval was occasionally observed, but with piece-workers this was quite a question of their own choice. The *air* conditions in these founding processes were determined as good in 17 places, only fair in 41, and decidedly hazardous to the health of the workers in the remaining 48. While quarters were usually spacious enough, the air was subjected to vicious contamination with brass fumes, usually, also, some lead fumes, in addition to the features mentioned under Iron Founding. While these fumes were only a matter of ten to fifteen minutes during pouring in smaller places and once or twice a

day, they became very detrimental to health where they were more or less continuously present.

In addition to brass fumes (the *poisonous* element of which is pre-eminently zinc, and causes when inhaled "brass chills," or "brassfounders' ague"), and lead (present as a hazard through handling, chiefly, but also in the form of dust and fumes), the following poisons were reported by investigators; antimony, sulphur dioxide, carbon dioxide, carbon monoxide, benzine, phosphorus and "salamander gases." These were usually present in small amounts only, but very liable to produce slow poisoning.

Because of the element of zinc, and also antimony when present, (the breathing of the hot fumes and sublimation products of which cause a drying harshness and soreness in the nose, throat and chest, and oftentimes a nausea and loss of appetite) the industrial inducement to *alcoholism* is much greater among these workers than among Iron Founders. It seems to be a tradition with brass molders to resort to stimulants for the sole purpose "of cutting the slug" in the throat, and to reduce the likelihood of brass chills, as well as "metal poisoning."

The average *appearance* of the workers was good in 62 places, fair only in 27 more, and bad in the remaining 17. In 42 places brass chills were complained about, while other *complaints* were about the same as those mentioned under Iron Founding. In 35 plants our investigators encountered the following cases of *industrial disease* complaints: brass poisoning (including "chills" mostly, but occasionally "brass itch") 104, and 40 others who said they had had chills in the past, or in places where they had previously worked. In some places 1/3 to ½ of the workers were suddenly stricken, usually in the winter time, during snowstorms, when the fumes hung about especially heavy within the quarters. As is the rule, these chills came on at night time several hours after the workers left the foundries. The wholesale manner in which they appeared was occasionally mistaken for an epidemic of some sort, resembling influenza. In addition to the above, our investigators discovered 4 cases of chronic lead poisoning, 4 others which were tentative, and 3 others who had been afflicted in the past with lead poisoning. There was also reported 1 case of chronic eczema, 1 case of benzine dermatitis, and many complaints of catarrhal conditions of the nose, throat and stomach.

Comments.—In addition to what has been said under Iron Founding, means should be taken to locally ventilate brass pouring areas. This may be done by means of broad hoods, connected with tall stacks, or a suction fan, and each hood capable of raising and lowering over the pouring area. Another method is to apply an exhaust hood, connected with a flexible duct, immediately over each crucible and its pouring edge, and lead the fumes off to a collecting chamber. While crucibles are being transported from furnaces to molds, practically all the fumes can be kept down by covering the surface of the metal with a little slag or sand. A hood or apron applied over the furnace area will usually provide for removing fumes which arise when the furnaces are opened and the crucibles are removed, and lead and other ingredients added. A factory check upon the reasons why employes absent themselves from work would prove instructive to employers and bring out the preponderance of preventable causes.

METAL GRINDING.

The process of metal grinding is one closely associated with foundry work and assembling processes upon both iron and soft metals. It properly includes

also the dressing of castings by other means than grinding, such as "sandblasting," "rattling" in tumbling machines, and "chipping" by means of steel tools. Sandblasting has been considered elsewhere, while a word will be given here to each of the other subsiduary processes. Metal grinding is usually performed with emery wheels, which may be stationary, or may be moved about over large surfaces by means of a swing-belt attachment. Occasionally it is done mechanically by a series of traveling emery wheels, which pass up and down over the surfaces to be ground. Sometimes it is done by belts covered with emery or other exceedingly hard abrasive substances. Carborundum and corundum, two substances of diamond-like hardness, are the chief abrasives used.

The process was investigated in 64 establishments, employing a total of 1,979 wage-earners, all males. Modern methods appeared to obtain in 42 places, fairly so in 14 more, but were crude compared to other places in the remaining 8. In but few places were the workers members of a union. The general attitude of employers toward this class of employes appeared good in 45 places, fair in 17 more, and poor in the remaining 2. A fairly intelligent class of workers were employed in 36 places, while more or less ignorant foreigners, often non-English speaking, were employed in the remainder. A fair percentage of the workers were comparatively old-time employes in 48 places, while the personnel appeared to change very often in 13 places (the remaining 3 were not reported upon). Health appliances, especially those consisting of blower systems to remove the dusts created, were good in 20 places, of only partial efficiency in 13 places, and absent in the remaining 31. These latter were places where workers were employed either on traveling belt grinders, which they steered about, and which were difficult to protect, or were engaged at the process for only a part of their time, as, for instance, stove-mounters. Definite instructions regarding the health-hazards of the work were given in an organized way in 8 places, and fairly well in 2 more, but the remaining 54 very little thought was given to the effect which the work might be having upon the health of the workers, and in a number of places very little attention was given to the efficiency of the blower systems present. In 8 places the workers were members of sick benefit associations, conducted by the industry itself. The work was considered skilled in 7 places, semi-skilled in 15 more, while entirely unskilled labor performed it in the remaining 42 places. The workroom quarters were hygienically constructed in 27 places, fairly so in 12 more, and not so in 21 (the remaining 4 not being reported upon in this regard). In 20 places other processes than metal grinding were carried on in the same quarters, such as Sandblasting, Machine Shopping, Foundry Processes, Forging and Smithing, Welding, Brazing, Furnacing, and Polishing and Buffing. The age-group estimations summed up as follows:

Age Groups.	*No. of Wage-Earners.*
Over 50 years	19
45 to 50 years	20
40 to 45 years	104
20 to 40 years	1,803
Under 20 years	32

The process was investigated in 16 different industries, arranged in descending order (by number of places investigated) as follows: Foundry

and Machine Shop Products, 11; Cutlery and Tools, 11; Brass and Bronze Products, 7; Automobiles and Parts, 6; Iron and Steel Mills, 4; Stoves and Furnaces, 4 (this was also separately investigated in the stove-mounting rooms in a total of 15 establishments); Agricultural Implements, 4; Musical Instruments, 3; Steel Springs, 3; Scales and Balances, 2; Electrical Apparatus, 2; Electroplating, 2; Coffins and Burial Cases, 2; and Sewing Machines, Safes and Vaults, and Files, each 1.

Vital Statistics for Metal Grinders are not given separate classification in the State reports. In this connection it is probable that country-wide statistics would be much more accurate, both because the larger number of deaths concerned, and because persons with bronchial or respiratory diseases have a strong tendency to migrate to western states. In this connection we publish the following, taken from a report submitted by the Stove Mounters' International Union (United States and Canada). These workers are engaged about one-fifth of their time in metal grinding, usually without any protective devices, while they are in an atmosphere more or less contaminated with the fine dust created most of the time.

Figures submitted by the Secretary-Treasurer of the Stove Mounters' International Union for death benefits paid in the United States and Canada for the past 5 years, show the four leading causes of death and percentages as follows:

Cause of Death and Percent from Each Disease Among Stove Mounters to Whom Death Benefits Have Been Paid by Their Organization During the Past Five Years in the United States and Canada (Under Date of September 17, 1914).

Tuberculosis	27.95%
Heart Disease	20.93%
Accidental Deaths	11.67%
Pneumonia	9.31%

The remaining deaths were as follows:

Deaths due to Preventable Causes	13.88
Deaths due to Degenerative Diseases	9.23
All other Deaths	7.03
Total	100.00

The total deaths chargeable to lung diseases was 43.5%.

The hazard of breathing *dust* from the process was determined as negligible in 9 places, of a fair risk to the average worker in 24 places, and bad in the remaining 31. This dust was invariably of a most harmful character because of its hardness, crystalline character, and fineness, making it easy of inhalation and swallowing. In 12 places quarters were kept *clean* and *orderly*, fairly so in 17 more, and not so in the remaining 35. Methods of cleaning were oftentimes at fault, such, for instance, as dry sweeping or brushing up during work hours. Only dirt floors were present in some places, and in others, floors, walls and ceilings were of such construction as to make them

very difficult to keep clean. Workers were found engaged in very *damp* quarters in 6 places, and fairly so in 4 others. Sometimes the water used in connection with the grinding process was the cause of the dampness. There seemed to be a tendency to put metal grinding in *dark* quarters. In 12 places this was especially noticeable, while light was inefficient in at least 13 more. In many of the 39 remaining the light would have been efficient, providing windows and skylights were kept reasonably clean. *Heat* was a negligible factor in the process itself, but in 5 places workers were exposed to this hazard from their proximity to furnaces and other hot processes. While heating was frequently done by stoves and indoor furnaces, occasionally the ordinary salamanders filled with coke were used, without stack and hood to remove fumes. In at least 5 places entirely inefficient heating methods were justly complained of, particularly for workers who stood or sat still all day with their backs toward windows, or drafty areaways. The general room *ventilation* of grinding quarters was good in 12 places, fair in 39 more, and bad in 21 (the remaining 2 not being reported upon). This feature in about one-third of the places, however, was influenced by the nature of other processes present, particularly founding, forging, and the like. In many instances these workers were exposed to foundry and cupola smoke, core-oven fumes, etc. Occasionally workers were just as much subject to brass fumes and "brass chills" as were the brass founders themselves. *Fatigue* was considered a bad hazard in 31 places, and fairly so in 29 more, the chief features arranged in descending order of importance being: monotonous application and reduplication of movements, 26; hurrying piece-work, 24; constant standing (still), 19; loud noises, 13; speeding up, 6; jarring processes, 6; laborious work, 5; faulty postures long maintained, many; seats without back rests, many; long hours, several; constant pressure of the body against objects, many. In 4 places work arrangements were adjusted to permit variation and recreation. For a large percentage of workers, especially those engaged upon small pieces, *inactivity* was a considerable hazard. The workday was 8 hours in 2 places, 8 to 9 hours in 13 places, 9 to 10 hours in 44 places, and 10½ hours in 1 place. The noon recess was 1 hour in 13 places, ¾ hour in 6 places, and ½ hour in 45 places Overtime was an occasional feature. A morning lunch hour or respite from work was seldom observed, although piece-workers suited themselves about this. The liability to the contraction of *communicable diseases* was a considerable hazard in 31 places, fairly so in 21 more, negligible in 8, and not reported upon in the remaining 4. While the whole gamut of hazards as listed in Parts II. and III. was encountered here, the chief ones were: promiscuous spitting upon the dusty floors, the absence of cuspidors, use of common drinking cups, inadequate or absent washing facilities, poor closets, crowding together of workers in a small space in the room, and the lack of medical supervision (particularly to keep consumptive workers from endangering others). Liability to *poisoning* existed in 17 places, and especially so in 9, due to work upon lead, lead alloys, and the breathing of brass fumes. Where lead is over 5% in an alloy, the dust from such alloy may produce lead poisoning. Most brasses and bronzes do not exceed this. The industrial inducement to *alcoholism* appeared negligible in 7 places, a subject for consideration in 34 places, and a decided hazard in 23, due, in addition to the depressing influences of the various hazards above cited, to the inadequacy of proper drinking water facilities. While any place employing a large number of workmen would be almost certain to have *some who appeared* below par in health, this was particularly so among a rela-

tively large number of employes in 13 places, and more or less so in 31 more. In 25 of the establishments visited the workers made *complaints,* which were worthy of notice. These consisted chiefly of the constant breathing of dust, causing all manner of nose, throat, bronchial and lung troubles, as well as dyspepsia, bowel trouble, and middle ear gatherings. Most of the complaints concerned general sanitary matters, and occasionally the breathing of fumes, vapors and smoke from other processes. In 17 plants the investigators came across 24 cases of *industrial sickness,* as follows: Chronic Lead Poisoning, 5; Pulmonary Siderosis, 5 positive and 4 tentative; frequent attacks of Brass Poisoning, 2; Bronchitis, 2; Tuberculosis, 2; Pneumonia, 1; Tubercular Empyema, 1; Brush burns of the hands, 1; Conjunctivitis, 1. As stated under Factory Processes, here too, the vast majority of such cases are in hospitals, dispensaries and various institutions, or at home, to which the existing system of morbidity statistics does not extend to any degree of efficiency at the present time. (See, however, Part II. and Part VI.)

Comments. — Our analyses show that only 5 plants could be considered entirely healthy places in which to work. The better control of the dust (in 11 places no attempts whatever were made to control it) is the first essential, while shorter work hours, alternation of work to overcome monotony, and the features mentioned under the respective hazards above, as well as medical examination and supervision are necessary to control health in this entirely unnatural and hazardous process. The wearing of a piece of board or metal prevents harmful pressure against the person.

TUMBLING consists in placing a number of castings (usually small ones) in a revolving cylinder, called a "rattler", in order to shake mold dust off of them, as well as to smooth down certain imperfections. The cylinder, which should be entirely enclosed, since it creates an immense amount of dust, was found not to be so in a number of instances. However, in some places, a very efficient air exhaust or blast system controlled all dust arising therefrom. The process is very noisy.

CHIPPING of iron and steel castings is another exceedingly dusty and also dangerous procedure from the flying particles which are created by the use of both hand or pneumatic tools, and from which a considerable part of the 1,220 working men (this was the number compensated for) lost their eyesight in the State in the year 1913. Outside of the use of respirators, individual goggles (to prevent the spread of eye diseases), and cotton in the ears, it is exceedingly difficult to protect the workers in this procedure. Where pneumatic tools are used the noise is deafening, while the shocks produced to the nervous system by holding the tools is most damaging. Short hours, work variations, physical examination upon employment, and medical supervision, should be instituted.

SAND BLASTING.

Sand blasting is a process in which fine sand or similar hard substance is forced through a pipe by compressed air against objects either for the purpose of cleaning their surfaces or of giving them an etched, frosted or rough effect. Hence, the process is used upon a considerable variety of materials. As it is very rapid, usually only a few workers are so employed even in very large establishments.

Our investigations covered the process in 9 different industries, viz., Automobiles, Cars, Carriages, Electrical Apparatus, Brass, Iron, Glass, Cutlery

and Tools, and Machine Manufacture. There were 51 wage-earners, all males, found so employed. For some work, considerable skill is necessary, but in the majority of instances it is a process for unskilled labor. Retention at the process was good in 3 places, fair in 3, and very brief in the remaining 3. Health appliances, consisting of isolation of the process in a room by itself and within a cupboard through which the worker inserted his hands, or the wearing of a helmet covering the entire head, — these features were found good in 3 places, fair in 3, and practically absent in the remaining 3. Instructions to limit the dust in order to conserve the health of the worker were good in 5 places, but very little attention was paid to the same in the remaining 4. In but 1 place did the workers enjoy the privilege of a sick benefit association. The work

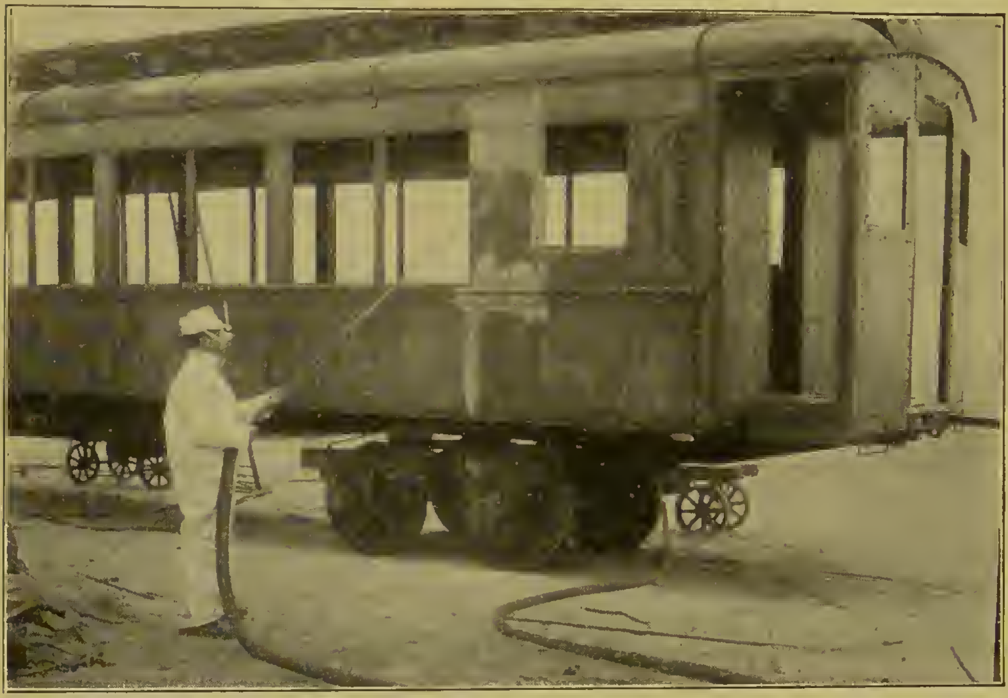

FIG. 40. SANDBLASTING.

The worker needs protection from breathing fine dust incident to this class of work, even though it is done out-of-doors. Note besides respirator, special suit and cap.

was done in the same quarters with other processes in 3 instances, so that other workers were exposed to the fine dust created. Of all the employes, 13 were over 40 years of age and 38 under 40.

Dust in the breathing atmosphere was a negligible factor in 2 places, a fair hazard in 4, and bad in 3. Cleanliness of quarters took about the same proportions. *Dampness* was no feature of the process, nor were harmful *light* effects. *Heat*, due to the proximity to other processes as a rule, was bad in 1 place, fair in 2 more, and no feature in the remaining 6. *Cold* weather, due to performing the work, protected only by a roof, was a feature in 2 places. *Fatigue* was not a special hazard, although hurrying piecework, monotony, and constant standing were features in ⅓ of the places. The workday was from 9 to 10 hours in all

places. The noon recess was 1 hour in 1 place, ¾ hour in 3, and ½ hour in 5 places. The liability to the contracting of *communicable diseases* was negligible in 3 places, a fair risk in 5, and bad in 1, due, principally, to the breathing of fine dust in quarters where there was promiscuous spitting, absence of cuspidors, inadequate washing facilities and improper closets, and the failure to inquire into the fitness of the workers for such work. Poisoning was no feature. The general factors favoring *stimulantism* were the irritating effects of fine dust inhaled and swallowed, and the absence of good drinking water facilities in some places. The health *appearance* of the workers was not good in ⅓ of the places. The workers' *complaints* were the breathing of dust, skin irritation in hot weather, and the inefficiency of some of the hoods used, while in 1 place the manager said they were having it done at night, because it made so much dust! *Comments.*— Such work should be done in a manner to keep the dust away from the employe, such as confining the process within an impervious cupboard, through which armholes are made, or having it done in a dust-tight room in which the worker should be supplied with an impervious suit and helmet to which is attached an air tube supplying him with fresh outdoor air under pressure. The simple wearing of respirators, even of helmets, without such air tubes is not at all efficient, as can be demonstrated by noting the amount of fine dust settled upon the workmen's features when such coverings are removed. Many places substitute sandblasting by cleaning small pieces in a rattler. For large work, the Wedemeyer sand blast rooms should be investigated.

POLISHING AND BUFFING.

The processes of Polishing and Buffing are so similar and work is so often interchanged that they are considered together. Polishing is done on emery wheels, or spindles covered with a composition of abrasive material, which gives a smoothness to castings much in advance of that secured by metal grinding, where the action is rougher. Buffing is a follow-up process which glosses the metal parts still further after they have been polished. Buffing is usually done with wheels composed of layers of fabrics tightly compressed and sometimes infiltrated with finely abrasive powders.

The process was investigated in 51 plants, located in 11 cities, and employing a total of 864 wage-earners, all but 2 of whom were males. The number of employes varied from 2 to 125 in a single plant. The females were engaged in a fibre comb factory.

The industries in which this process was investigated were as follows: Brass and Bronze Products, 15; Electrical Apparatus, 5; Mirror Making, 5; Cash Registers, 3; Stoves and Furnaces, 3; Foundry and Machine Shop Products, 3; Coffin Fixtures, 3; Cutlery and Tools, 3; Copper, Tin and Sheet Metal Goods, 2; and 1 each of the following — Automobiles and Parts; Jewelry; Regalia; Scales and Balances; Sewing Machines and Parts; Scientific Instruments; Fibre Combs; Aluminum Combs; Signs and Advertising Novelties. The metals or alloys usually worked upon were brass, bronze, aluminum, lead and nickel plated objects.

The State Vital Statistics do not give sufficient reports to include here, but the following is taken from a report submitted by the General Secretary-Treasurer of the Metal Polishers, Buffers, Platers, Brass and Silver Workers Union of North America:

Of 197 deaths which occurred among Polishers and Buffers in the five-year period from June 1st, 1909, to May 31st, 1914, according to the record of death claims paid, the chief causes of death and the percentages were: —

POLISHERS AND BUFFERS.

Cause of Death.	*No. of Cases.*	*Percentage.*
Tuberculosis	65	33.0
Pneumonia	26	13.2
Heart Disease	22	11.1
Violence (including 6 suicides)	16	8.1
Other preventable deaths	14	7.1
Other deaths from degenerative diseases	47	23.9
Permissible deaths	7	3.6
Total	197	100.0

The average (median) age at death of these 197 workers was 39.7 years.

Three of the plants visited were union places, the balance being non-union or open shop. The employers' interest in employes' welfare appeared good in 30

FIG. 41. BUFFING METALS.

Note goggles, gloves, chest protector, good natural and artificial light, as well as ventilating system.

places, fair in 10, and poor in 7, the remaining 4 not being reported upon. An intelligent type of workers was found in 38 places, fairly so in 8 more, and ignorant foreigners in the remaining. There was a good degree of steadiness at the trade in 35 places, fairly so in 12 more, and not so in the remaining 4. Health appliances, consisting of blower systems to remove dust, lint, etc., from the process, were present in 38 places where needed, and absent in 4 (brass, combs, coffins, jewelry). In 19 of the places where they were present, they were not efficient; occasionally they were not in working order at all. Occasionally other appliances to improve room ventilation were also found. In 3 places organized instructions concerning the conservation of health were well given, and some attention was directed to this in 3 more. In 3 places the wage-earners enjoyed the privileges of sick benefit associations. The general construction of work quarters was hygienically good in 15 places, fairly so in 9 more, but not so in the remaining 27. In 22 places other processes were also being carried on in the same quarters, such as Electroplating, Machine Shopping, General Factory Processes, Founding, Lacquering, Metal Grinding, Soldering, Glass Melting, and Tinning.

Dust in the breathing atmosphere was a negligible hazard in 12 places, fairly so in 17 more, but was bad in the remaining 22. It consisted chiefly of iron, steel, brass and bronze alloys, other soft metals, glass, etc., which were being worked upon, as well as the components of the polishing wheels (emery, silica, etc.) and of the buffing wheels (cotton and lint fibres, glue substances, etc.). In some places it was kicked up from the floors because of inefficient cleaning, and also dry sweeping during work hours. These dusts are of course the most harmful to which workers may be subjected, since they are exceedingly hard, crystalline, and very fine, or irritating, and, in the majority of instances, poisonous. There are so many consumptives in the trade that the infection factor is also added. The general cleanliness of quarters was determined as good in 15 places, fairly so in 15 more, and not so in the remaining 21. This usually was due to negligence in cleaning up, but oftentimes also to the type of quarters occupied. In many such places windows and skylights were apparently very seldom cleaned, or walls painted or whitewashed. In 7 places *dampness* and poor light were hazards. General room *ventilation* was very good in 16 places, fairly so in 17 more, but close and confined, and often contaminated with various fumes and gases from other processes in the remaining 18. In but 2 places were workers exposed to *heat*, and here it was not bad. In practically all places polishers and buffers were subject to the effects of *fatigue*, and particularly so in 22. The chief reasons for this were steady, monotonous piece-work under constant application and considerable strain with eyes and body almost rigidly fixed for a total of hours at a time throughout the day. Constant standing in partially stooped postures with very little variation were also other hazards. The workday was found to be 8 hours in 1 place, 8 to 9 hours in 14 places, 9 to 10 hours in 30 places, and 10 to 11 hours in 2 places. The noon recess was 1 hour in 11 places, ¾ hour in 7 places, and ½ hour in the remaining 33. The question of other recesses was very largely a matter of the workman's own choice, since they were employed at piece-work. The liability to the contraction of *communicable diseases* was great in 24 places, and considerable in at least 18 more, due particularly to promiscuous spitting on dusty floors and the absence of cuspidors, while in a fair percentage of places washing facilities were absent or very inadequate; often closets were poor and common cups

used by all workers for drinking purposes. In some places workers were unduly crowded together. Occasionally, some were seen who were wearing respirators and endeavoring by this means to filter out the dust from the air which they inhaled. Liability to industrial *poisoning* existed in 38 of the plants visited, and especially so in 21. This was due in about half of the instances to the presence of other processes (see those mentioned above), in the balance it was due to working upon poisonous metals and alloys, particularly those composed of lead, or rich in lead component. The various poisons mentioned to which polishers and buffers were found subjected were lead, potassium cyanid, nitric acid fumes, phenol, amyl acetate, benzine, alum, crude paraffin, and "metal dust", furnace gas fumes, brass fumes, plating fumes, and acid-dipping fumes. The exposures varied greatly as to frequency, amount and workplace. The industrial inducement to *alcoholism* and to other forms of *stimulantism* were considered a marked hazard in 12 places, and more or less so in nearly all of the balance, based chiefly upon the fatigue factor concerned, the dust breathed, and the opportunities for slow poisoning.

However, in 24 plants the general health *appearance* of the workers was good, in 14 it was determined as fair, and in 13 bad. The principal *complaints* of the workers were monotony, danger, metal dust, acid fumes, blowers and exhausts inefficient, and poor sanitary arrangements, while their more personal complaints were coughs, indigestion, rheumatism, and skin affections. Investigators encountered 17 cases of *industrial diseases* in 8 plants as follows: chronic lead poisoning, 5 positive, 1 tentative, and 1 past; brass poisoning, 1 positive, 1 tentative, and 6 with "brass itch"; severe bronchial affections were particularly mentioned in 2 instances.

Comments.—As the constant breathing of harmful dust and the continual assuming of unnatural and strained postures are foreign to the physiology of the human organism, it is highly necessary that dust be kept out of the breathing atmosphere and to introduce measures which will vary the work for this class of workers. Unfortunately, it is looked upon as a skilled trade and this makes it difficult to introduce work variations. This does not detract, however, from its hazardous character. The toll of deaths from preventable causes bears this out. It is a process of modern times. One point which particularly impressed our investigators was that where blower systems were intalled they were often very inefficient at the time of inspection and were said to be so most of the time. There appears to be but one way of getting around this — to make it somebody's business in each such room to see that such systems are in working order and to provide for compensation for this purpose. A metal or wooden "chest-protector" prevents harmful pressure against the person. Other features, the liability to poisoning, etc., require the same precautions as elsewhere. Especially should medical supervision be adopted for this class of workers, as they are at a process which appears to take about 20 or 25 years off of their lives.

MACHINE SHOPPING.

The process of Machine Shopping includes a considerable number of sub-processes and operations upon cast metals. These consist, principally, in turning, lathing, planing, drill-pressing, punch-pressing, threading, tapping, cold riveting, sawing, cutting, assembling, and the like. All of these processes are

characterized by the fact that they are not carried on ordinarily with the aid of heat, nor is there much necessary creation of fine dust. The workers usually are more or less skilled. (Strictly routine machine operations carried on as piece-work by unskilled laborers have been considered mostly as General Factory Processes.)

Machine Shopping was especially investigated in a total of 56 plants, located in 8 cities, and employing 4,082 wage-earners, of whom 3,897 were males, and 185 (engaged in 2 factories), were females. These latter were working upon machines which threaded bolts, nuts, etc.

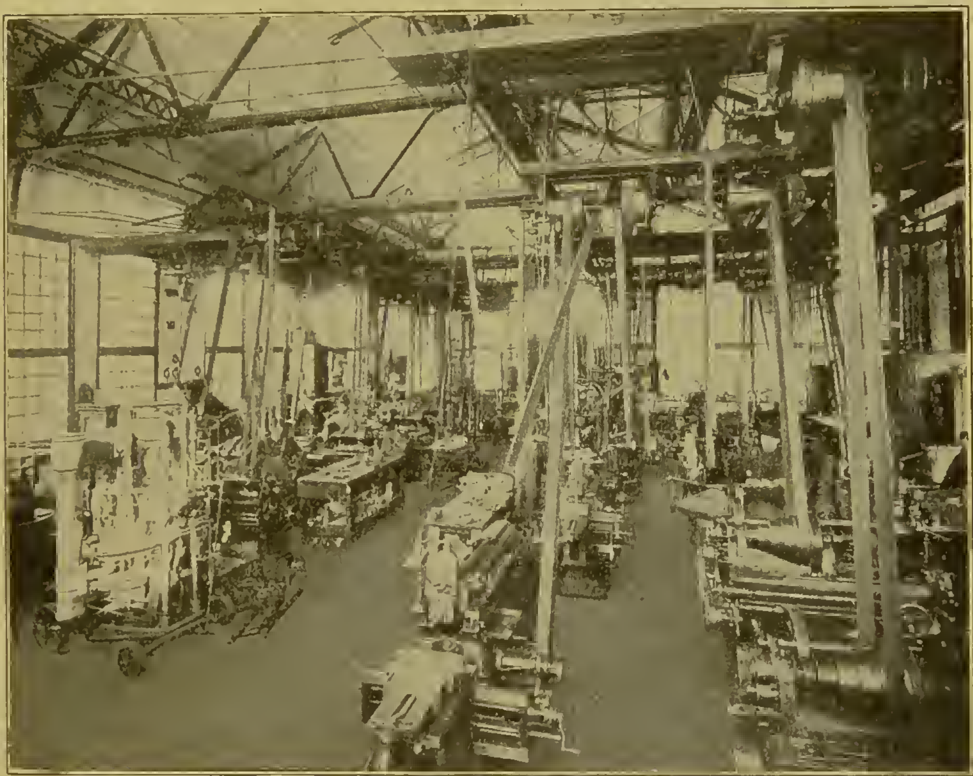

Fig. 42. A Model Machine Shop.
Maintained by a glass factory.

The process was investigated in connection with the following industries, arranged in descending order: Foundry and Machine Shop Products, 16; Cutlery and Tools, 13; Automobiles and Parts, 6; Brass and Bronze Products, 4; Electrical Apparatus, 3; Agricultural Implements, 2; Springs, 2; and 1 each of the following: Cars; Coffins, Copper and Tin; Files; Furniture; Shipbuilding; Stoves; Bolts and Nuts; Scales and Balances; Stamps and Stencils; and Iron and Steel Forgings.

Mortality Statistics for Machinists have been stated in Part IV., under Foundry and Machine Shop Products.

Only one plant visited was a union shop, the balance being "open shop". The employers' interest in the workers' welfare appeared very good in 42 places, fair in 7 more, bad in 3 (and not reported upon in the remaining 4).

In some 14 plants a good percentage of ignorant workers were employed in various helping and routine processes. Retention of workers at the places employed seemed to be good in all except 4 instances. Usually, special health appliances for machine shop processes are not needed. Safety devices were almost everywhere present. In 6 plants excellent arrangements were found for general room ventilation. Organized instructions along health lines were given in 7 places, and some attention to this in 1 or 2 more. The workers had sick benefit privileges in factory organizations in 6 instances, although in 2 of these only a part were covered. The general construction of machine shop quarters was good in 35 places, fair in 6, and bad in 10 (the remaining 5 not being reported upon). In 22 places, other processes were at hand, such as Metal Grinding, Polishing, Tempering, Wood Working, Painting, Welding, Blacksmithing etc.

Age group estimations summed up as follows:

Age Groups.	*Number of Wage-earners*
Over 50 years	75
45 to 50	271
40 to 45	491
Under 40	3,245

Dust was no hazard in 35 places, and in but 3 was it marked enough to demand attention and here it was due to other processes (grinding, polishing). Thirty-two places were kept very *clean* and orderly, 10 more fairly so, and the remaining 14 not so. Cuspidors and refuse cans were present more often in machine shops than most other places investigated. Dry sweeping during work hours was occasionally observed. In 5 places quarters were rather *damp,* due to location, and, occasionally, wet grinding. Natural *light* was good in 46 places, fair in 5 more, and poor in the remaining 5. In a considerable number of places artificial lighting was done chiefly with naked electric lamps, suspended overhead, and often very inefficient as regarded general room illumination. In 1 place mercury arcs were used for lighting. The *air* condition of the various machine shop processes seemed good in 41 places, fair in 12 others, and poor in only 3. This high percentage of good air condition is due to the usually spacious quarters, and the absence of industrial factors in the process to contaminate it. *Fatigue,* in the general routine of machine shop work, is a negligible factor, but a good percentage of the employes were found to be subjected to various hazards as follows: hurrying piece-work, 14; excessive noise, 12; constant standing still, 8; monotonous application, 3; while sedentary processes on chairs or stools without backs, faulty postures, jarring processes, (pneumatic tools, drop presses, etc.) and prolonged pressing of objects against the person were observed in many manipulations. The workday was found to be from 9 to 10 hours in all except one place, where it was 10¼. Saturday afternoons were about evenly "off" and "on". The noon recess was 1 hour in 1 place, ¾ hour in 48 places, ½ hour in 2, and not determined in the remaining 1. The liability to the contraction of *communicable diseases* was considerable in 6 places, fair in 21 more, and questionably negligible in the remaining. The chief factors, where present, were the use of common drinking cups, poor closets and washing facilities, and promiscuous spitting. The oil-soaked floors

and lack of dust, however, in a great majority of places, rendered the hazard less likely. Another hazard observed was the likelihood of infections from the use of wiping rags and waste from any and all sources. Particularly should be mentioned here virulent pus infections (blood poisoning), erysipelas, lockjaw, as well as the problematical acquisition of contagions, such as smallpox, diphtheria, measles, tuberculosis, and other communicable diseases like typhoid fever. Our attention was called in 1 place to the fact that tubercle bacilli had been isolated from the oil used in screw machines, evidently due to the fact that workmen spit into it during its flow through the machines. It was found that the "safety first" idea had spread the principles of "first aid" in preventing infections in a number of places. The only *poisons* encountered in machine shopping were occasional exposures to lead (in tempering, soldering, in rich lead alloys worked upon), benzine, paint solutions, and brass. Occasionally forge gases and potassium cyanide tempering or case-hardening were carried on. The industrial inducement to *alcoholism* and stimulantism was considered a fairly negligible factor in almost all places. Where present, such was due to fatigue factors, the absence of good thirst-assuaging facilities, and the depressing influence of general insanitary conditions.

The general *appearance* from a health point of view of the mass of workers in this process was good in 43 places, fair in 8 more, and not good in the remaining 5 — the latter including some large places where a poor class of help and females were employed. The *complaints* which workers made were localized to certain insanitary conditions in their own plants. Our investigators came across 2 cases of open consumption, and here and there skin afflictions, such as "brass rash" and certain numbers of pale, anemic and unhealthy looking workers. *Comments.* — The reduction of certain monotonous and hurrying piece-work operations for workers in some plants, and attention to general sanitary and hygienic features are the suggestions offered. The more general use of goggles, gloves, cotton in the ears for noise, and first-aid equipment is needed in many places. Obviously, the presence of other noxious processes should be separated from that of machine shopping.

Boiler Making is a procedure in which at least two hazards were found to exist: excessive noise of a reverberating character, producing in practically all workers deafness usually of considerable extent; and heat, where workers were in confined spaces during the process of hot riveting.

Riveting is a process in which excessive noise is produced, which is considerably worse if in confined quarters. Workers who handle pneumatic riveters have the same hazard to the muscular and nervous systems as do all workers using these vibrating types of tools. "Occupational neurosis" is the term applied to the condition which develops.

TEMPERING.

The process of tempering, that is, hardening of metals and metal surfaces, was found to be carried out by several methods: simply heating and cooling, or heating and dipping into water or brine, or dipping into hot baths of lead, oil or potassium cyanide, or sprinkling on potassium cyanide and heating in an oven. Case hardening was done chiefly with potassium cyanide.

The process was investigated in 31 establishments in 9 cities, and employed a total of 326 wage-earners, all males. It was found to be used in connection

with the following industries: Cutlery and Tools; Foundry and Machine Shop Products; Springs; Automobiles and Parts; Bolts; Nuts; etc.; Electrical Apparatus; Files; Sewing Machines; Bicycles and Parts; Iron and Steel Mills; Stamps and Stencils; and Cash Registers.

Tempering was usually done in connection with the blacksmithing and forging quarters, but, occasionally, elsewhere. It required expert men for some purposes, while a considerable number of ignorant foreigners were engaged at it for other purposes. Health appliances consisting of hoods with vents (and sometimes air blasts and fans to blow back heat and fumes) were found efficient in 5 places, fairly so in 8 more, and absent in 18 (in a few of which but little tempering was done). Some instructions concerning avoidance

Fig. 43. Blacksmithing and Tempering.

Note ventilating hoods and stacks over furnaces. The stove-like furnace to the left is where tempering is done in molten lead or potassium cyanide.

of poisoning were given in 4 places, but in the majority of places, where the most deadly poison was used (potassium cyanide), ignorant workmen were employed in handling it. In 7 of the places visited the workers had the privilege of sick benefit associations. In 9 of the 31 places, other processes were conducted in the same quarters with tempering (Forging, Machine Shopping, Metal Grinding, Pickling, etc.). Age group estimations showed 3 over 50; 75 between 40 and 50; 228 between 20 and 40; and 15 under 20 years of age.

The hazards of *dust, dirt, dampness, poor light, heat, cold, infections* and industrial stiumulantism were practically the same as for Forging and Blacksmithing. The *fatigue* factor appeared to be somewhat less. In a few places one cause was hurrying piece-work, along with monotonous application. In some instances the work was very sedentary. Noise from air blasts and other

processes was also noted. The workday was found to be 8 hours in 2 places, 8 to 9 hours in 4 places, and 9 to 10 hours in the remaining 25. The noon recess was ¾ hour in 2 places, and ½ hour in the remaining 29. Overtime was seldom called for. *Poisoning* was found to be a great hazard in this process. In 15 of the plants there was a liability to lead poisoning, and in nearly the same number to acute and chronic poisoning from potassium cyanide. Both of these were dangerous in the form of handling, and hot fumes. It was very common to see large pieces of potassium cyanide lying on the edge of melting pots, or nearby, where it was handled by working men of the most ignorant class, often unable to speak English. Other poisons encountered were sulphuric acid, and the decomposition products of hot oil, as well as escaping furnace fumes.

The general *appearance* of workers was good in 19 places, fair in 8 more, while most were sickly looking in the remaining 4. The complaints of workers were the metallic and oil fumes, heat exposure and drafts. In 8 plants our investigators found 13 instances of industrial disease, as follows: lead poisoning, 12 (7 positive and 5 tentative); dermatitis from potassium cyanide, 1. In another instance a peculiar death was called to our attention which may have been due to potassium cyanide.

Comments. — As potassium cyanide is the most deadly poison used industrially, and as the form in which it is used is the straight chemical compound itself, none but well instructed workers should be employed in its use. All pieces of it should be kept securely locked up, while melting pots should be well hooded and the fumes carried to the exterior. The same precautions should be taken concerning lead as described elsewhere. The workers in many places should also be protected from heat by such means as screens, asbestos shields, air blasts, dark goggles, and, as for all hot-process workers, shower bath provisions. Gloves should be furnished and their wearing insisted upon. In only 2 plants were anything like sufficient precautions taken against poisoning by lead, or potassium cyanide. The use of patented substances to replace potassium cyanide and claimed not to be poisonous has been called into question by chemists in the case of one of them at least. It is declared that this substance broke up and yielded the poisonous cyanide radical when melted for use.

BRAZING.

Brazing consists in the heating of two metallic objects in contact until they fuse, usually with the aid of a hard solder, which contains the elements of brass. It is usually done in forges, or at benches by means of a blowpipe or blast. It is adaptable especially to non-ferrous metals.

Our investigations covered the process in 4 establishments, in 3 cities, representing 53 wage-earners, all males. The work is more or less skilled. There were no unions. There were also no appliances to remove fumes from the vicinity of the workers. In 1 place goggles were furnished, and the workers were also privileged members of a benefit association. The workday was 10 hours in all places, with ½ hour noon recess, except in 1 place, where 1 hour was allowed. In 2 places the work was done in very poorly ventilated quarters, while in 3 places other processes were carried on in the same quarters. There were a total of 10 workers over 40 years and 3 under 20, leaving the balance (40) between 20 and 40 years.

The chief hazard was found to be the fumes which arose during the process, and were composed very largely of zinc, mixed with fuel gas. In 3

places, 7 workers were found who were subject, off and on, to "brass chills" or "braziers' disease." In 1 case a grinder in a neighboring room also suffered similarly. The condition was said to be much worse in the winter. In addition to this hazard, the general *ventilation* of quarters was bad, the *heat* was rather oppressive, while no particular precautions were taken against any of the features which tend to promote *communicable diseases.* Because of the peculiar drying and irritating effect of these fumes upon the throat, there was great inducement to industrial *alcoholism* among workers so employed.

Comments. — With few exceptions all brazing stands should be carefully hooded and a good draft provided to remove zinc oxide, and other metallic fumes and gas, as they escape.

WELDING.

The processes included here are those of acetylene, oxyhydrogen, and electric welding. A brief intervaled contact, such as one sees in the working upon street car rails, was the nature of the electric process occasionally observed. Usually, however, the low voltage and high amperage welding were the processes seen. The other forms were less brilliant, but apt to be more prolonged. Welding was investigated in 18 establinshments in 7 cities, and employed 159 wage-earners, all males. The industries concerned were Coffins and Burial Cases; Copper, Tin and Sheet Iron Goods; Automobiles and Parts; Iron and Steel Forgings; Stoves and Furnaces; Toys and Games; Cutlery and Tools; Scientific Instruments; Cars; Iron and Steel Rolling Mills; and Safes and Vaults.

More or less skilled hands were employed in 11 places, but ordinary labor in the remaining. Such work was done only at intervals in a number of places. In some 6 places, the workers were, clearly, difficult to keep at the process. There were no union organizations. In 2 places the workers had sick benefit privileges. Appliances consisting of shields to protect the eyes were good in 3 places, and fair in 4 more, while in the remaining 11, in which the brilliancy of light was not quite so great, such protective appliances were not worn. Welding was usually performed in a room by itself, but in 5 places it was done in connection with Machine Shopping, Forging, Tinsmithing, and Metal Grinding. The age group estimations were as follows: over 50 years, 2; between 45 and 50 years, 2; from 20 to 40 years, 155.

The chief hazard of this process was the exposure to the *light,* and, in the case of high voltage electric welding, at least, to the effect of actinic rays. The dazzling brilliancy of the light (said to reach 8,000 candle power and a temperature of 7,000° F.) was rendered even more harmful by the fact that it was performed in poorly lighted quarters in a number of places. The light was found to be not only a hazard to the eyes, but also to the skin, even beneath the clothing. In 2 places workers were found suffering from conjunctivitis. Others complained of inability to read at nights, headaches, sore eyes, weak eyes, of the breathing of fumes, and the showers of sparks produced, while hearsay cases of *ophthalmia electrica* were brought to our notice. This is a condition in which, after a brief exposure, the eyes later become greatly inflamed and swollen, and exceedingly painful, the condition lasting from a few hours to several days. The extent of permanent damage to the sight and color sense is not fully known, but permanent weakness and cataract has followed. The rays, particularly from high potential electric welding, also produce "sun-

burning" of the skin. This was a feature complained of in 5 instances. Being similar to the X-Ray, there is danger of a subsequent formation of cancer, as well as the production of sterility in workers so exposed.

In 7 places workers were found to be employed at piece-work. In 4 places there was danger also of poisoning, especially from lead and brass alloys, upon which the work was being done.

Comments. — All persons with weak eyes should avoid this process. An oculist should see all employes before they are engaged. All such workers should be provided with protection to the eyes, both against sparks and for the light. While in some forms of the process the amount of light produced can be easily borne, its alternate flashing and disappearing is damaging to the human eye. In a number of places, complete helmets or head shields, equipped with layers of red and blue glass in front of the eyes, were provided. These should have been used in some other places where only common dark glasses were provided. For the actinic and X-Rays produced, the worker should wear gloves, and at least heavy leather aprons, if not some form of lead foil incorporated in special cloth. Some forms of glass (Euphos and Hallaner glass) are said to absorb electric and actinic rays. Where fume is produced, suction fans, hoods and other exhausts are necessary.

SOLDERING.

Soldering may be done by hand, or by machinery, the latter especially in the case of the manufacture of tin cans or the sealing of the same in canning factories. In this place we have also included LEAD BURNING, as such work is practically the same as that of soldering (see also Storage Batteries). Solder contains from 30 to 60 per cent of lead. (For hard soldering see "Brazing".)

The industries in which soldering was investigated were as follows: Copper and Tin Goods, 6; Electrical Apparatus, 7; Stoves and Furnaces, 4; Paint Manufacturing (making tin cans), 3; Automobiles and Parts, 3; Instruments, 2; and 1 each of the following: Brass Goods; Cars; Coffins; Art Glass; Oil Refining; Shipbuilding; Advertising Novelties; Machine Shop Products; Rubber; and Chemical Manufacturing. There were a total of 35 establishments in 10 cities investigated, employing 749 employes, of whom 584 were males and 165 were females.

A union organization existed in 1 establishment. The employer's interest in workers' welfare appeared good in 29 establishments, and fair in the remaining 6. An intelligent type of workers was engaged in 27 establishments, while in the remaining 8 a large percentage of ignorant foreigners were employed at the work. Workers appeared to remain well at the work in at least 27 places. Health appliances, consisting principally of hoods and exhausts, or blow fans to remove solder fumes and gas fumes from the vicinity of the workers, appeared good in 2 places, of fair efficiency in 12 more, but absent in the remaining 21. In 4 places some organized instruction was being given in health conservation. In 6 places workers had the privileges of factory benefit associations. In 19 plants the work was practically all unskilled, and in some of these machines performed the actual process. Workrooms were hygienically constructed in 16 places, fairly so in 11 more, and not so in the remaining 8. There was an estimated total of 10 persons over 50 years, 20

between 45 and 50 years, 74 from 40 to 45 years, 610 between 20 and 40 years, and 41 under 20 years. In 14 places other processes were carried on in the same premises, such as Machine Shopping, Polishing, Welding, and Factory Processes.

In 2 places *dust* was a bad feature, due to the presence of other processes, and the same was true to a less extent in 7 more. Such dust helped to spread solder-dust accumulations. Quarters were *clean* and orderly in 21 places, fairly so in 10 more, and not so in the remaining 4. Natural *light* was bad in 2 places and only fair in 4 more, while the same faults were to be found with artificial lighting, as discussed elsewhere. (See Machine Shopping.) General room *ventilation* was good in 9 places, fair in 12 more, and bad in the remaining 14, due to close, stuffy quarters in which the air had no movement; to devitalizing of the air through the presence of gas flames, used in heating the solder; and to the contamination of the air with the products of gas fumes, solder fumes, smoke and acid fumes. In 10 places heat from the process was some hazard to health, due largely to the absence of hoods, protective devices, or air blasts to direct it away from the workers. The process of soldering is not particularly *fatiguing* in itself, but, in a number of hand-work methods, hurrying piece-work, speeding up, monotonous application at similar movements, and constant strain, involving also the eyes, were features, particularly as a fairly large number of youthful persons were so engaged. The workday was found to be 8 hours in 1 place, 8 to 9 hours in 12 places, 9 to 10 hours in 20 places; while in 1 place, employing 2 men, it was 11 hours per day, and 13 hours at night. The noon recess was 1 hour in 7 places, ¾ hour in 4 places, ½ hour in 23 places, and "as desired" in the remaining 1. Where there was no night shift work, there was apt to be a little overtime. The liability to the contraction of *communicable diseases* appeared negligible in 6 places, a fair hazard in 16 more, but a considerable hazard in the remaining 13. The chief reasons for such hazards were spitting upon floors, the absence of cuspidors, inadequate washing places, the use of common towels and drinking cups, poor closets, and the lack of medical supervision. The chief hazard in soldering is that of *poisoning,* due to lead (handled, in the shape of fumes, or as fine dust accumulations); acids, such as hydrochloric, and acetic (chiefly as hot vapors); and zinc chloride fumes, resulting from work upon zinc alloys with hydrochloric acid and a hot soldering iron. Near-sighted persons, and others, through habit, often kept their faces dangerously close to the fumes arising during hand-soldering. Occasionally wood alcohol was also used. With machine soldering the hazards of poisoning were somewhat less, although the extra quantity of fumes present increased the danger unless ventilation about the machines was very good. In 5 places, employing 70 persons, the risks of poisoning appeared negligible; in 15 more there was considerable hazard, while in the remaining 15 it was bad. Inadequate washing facilities and eating at the work benches or around the machines were decided factors, in addition to the methods of working. The industrial inducement to *stimulantism* was about in proportion to the effects of the poisons, since the other hazards were not considerable. Added to this was the frequent inadequacy of drinking water facilities in a number of places.

The general *appearance* of the workers averaged good in 21 places, fair in 10 more, and bad in the remaining 4, although here and there a pale or sickly looking worker was found in nearly all places. The chief *complaints* of the

workers were the obvious danger from breathing lead fumes, the effects of acid and other fumes upon the nose, eyes, and throat, the poor ventilation of work quarters, and the danger of getting foreign bodies in the eyes. Personal complaints were sore nose, sore throat, pains in the chest, nausea, loss of appetite, coughing and headaches, in addition to various digestive and nervous disorders which were often clearly due to slow lead poisoning. In 12 places our investigators reported the following instances of *occupational diseases*: lead poisoning, positive, 6; tentative, 4; partially recovered from, 3; a number of hearsay cases were reported; in addition there were cases of tuberculosis, which the fumes appeared to activate.

Comments. — None but healthy workers, who have passed nose, throat, eyes and chest examination should be employed as hand-solderers; work should be so arranged that either the worker is not continually bent over the soldering iron, or a local flexible exhaust arrangement is provided to remove fumes. Particularly is this so where workers have to enter confined spaces, as installing refrigerators in cars, etc. Needless to say that in all rooms in which gas flames are burning constantly, extra efforts towards renewing the air, and especially towards keeping it in motion should be made. Placards warning employes upon how to prevent lead poisoning should be posted up, while in certain sub-processes, workers should be examined periodically for evidences of lead poisoning, when, if found present, they should be put at some other work for a time. — There is also danger of arsenic poisoning wherever acids are used upon metals (the arsenic being present in both the crude acids used and in the metals). Symptoms are apt to come on hours after breathing the fumes with difficulty in breathing leading to pneumonia-like signs, pains in the abdomen, passing of blood in the urine, onset of jaundice and finally death perhaps after several days. (Arsine is the poison inhaled.)

PICKLING.

"Pickling" is a process to remove the "scale" to which sheet iron, black plate, etc., is subjected in preparation for galvanizing or tinning. It is practically always done with the aid of machinery, which dips the sheets up and down in the pickling solutions, the sheets standing on edge in the racks of a cradle. It is the duty of the workers to place the sheets in the cradle, move or revolve the cradle from one vat to the other, and to take the sheets out when finished. In the case of pipes and other articles the mechanical process, of course, differs somewhat. The solutions used are usually a double acid bath, "black pickle" and "white pickle," in which sulphuric acid, in comparatively weak solution in hot water is used, or hydrochloric acid may be used in cold water. Thereafter the pickled material is rinsed in running water, or in alkali water and then plain water.

The process was investigated in 16 establishments, in 12 cities, and in the following industries: Iron and Steel Mills; Tinning; Galvanizing; Automobiles; Wire; Foundry and Machine Shop Products; Signs and Advertising Novelties. There were a total of 180 wage-earners employed, all males. In but 1 small place was the process done by hand. As a rule, but a comparatively few men were required to perform this work, even in large establishments. In the places investigated, the attitude toward employes seemed very good in 10 places, fair in 5 more, and bad in 1. The type of workers was good in 6

places, fair in 4, and largely ignorant foreigners in the remaining 6. The men appeared to remain fairly well at the work in 14 of the 16 places. In 3 places health appliances, consisting of hoods covering the pickling vats, were good; in 2 places they seemed fairly efficient, in 1 place, bad, while in the remaining 10 they were entirely absent. Some instructions were given concerning employes' health in 1 place, and in 4 places sick benefit associations existed. The work quarters were hygienically well constructed in 7 places, fairly so in 4 more, and not so in the remaining 5. Other processes were present in 6 places, usually Galvanizing, but in large mills various kinds of work were done in the same premises. Age-group estimations summed up as follows: over 50 years, 3; between 40 and 50 years, 14; and between 20 and 40 years, 163.

Dampness was a considerable hazard in 5 places, and to some extent in 8 more, due to the splashing of floors from the process and the absence of good drainage. In 4 places *light* was very poor and in 2 others it should have been much better. The *ventilation* of quarters was not good in half of the places. In 4 places exposure to *heat* was a hazard, and particularly so in 1. There was also some risk from *cold* drafts, combined with working in a humid and steamy atmosphere. For the type of men employed the work itself was not *fatiguing,* although considerable lifting, constant standing, monotony, and hurrying piece-work, combined with evidences of "speeding up," were present. In addition, hours were uncommonly long in some places. The workday was found to be under 9 hours in 2 places, 9 to 10 hours in 7 places, and from 11 to 12 hours in the remaining 7. The noon recess was 1 hour in 5 places, ¾ hour in 2 places, ½ hour in 8 places, and "as desired" in 1. Night shifts were the rule in some of the places. There was some risk of contracting *communicable diseases* in all except, possibly, one place, due to the use of common drinking cups, absence or inadequacy of washing facilities, crude sanitary conveniences, frequent injuries and cuts, short-intervaled handling of materials by different workers, etc. While few precautions were observed as to spitting, the floors were usually wet, and dust was not a feature. The liability to *poisoning* lay in the effects of acid fumes and in one or two instances, alkali vapors, as well as hot cyanid solutions in adjacent electroplating processes. While sulphuric acid itself is not volatile, steam particles easily carry it. The same may be said of the alkali solutions. The effects of such poisonings are local upon the nose, throat and digestion, and especially upon the teeth; as the fumes also incite coughing, they are very predisposing to lung diseases. The solutions are usually not strong enough to affect the skin or eyes, except in the case of overly susceptible persons. The inducement to industrial *alcoholism* depends, first, upon the amount of nausea or gastritis which the breathing of the fumes may produce; second, upon the depressing influences of long hours, lack of good drinking facilities, and washing facilities. The workers perspire very freely. The work is sloppy and steamy.

The general *appearance* of the workers was good in 6 places, fair in 9 others, and bad in the remaining 1. Their chief *complaints* (although a comparatively few complained at all) were irritation of the nose and throat, coughing, heat, fatigue, and breathing of sal ammoniac fumes from nearby galvanizing processes. Our investigators found a considerable number of workers with very bad teeth, as well as pyorrhea, the effects, unquestionably, of the small but constant amount of acid vapors which they breath.

Comments. — In 1 place the employer remarked that "the men get fat on it," but all who were seen were sickly looking, while the Tuberculosis Depart-

ment in that city had notified us of a case of consumption which had come from the pickling room of this plant. In addition to hoods and stacks to draw off fumes, or drop-partitions around pickling vats, workers should be supplied with every convenience to keep dry, and to enable them to go home properly clothed, such as rubbed boots and aprons while at work, and locker rooms, shower bath quarters, etc., for bathing and changing purposes at quitting time. — See Comments on arsenic poisoning under "Soldering," whenever acids are allowed to act on metals.

GALVANIZING.

Galvanizing consists in the dipping of previously "pickled" sheet, pipes, or other metal ware (iron or steel) into baths of molten zinc, in order to give them a very thin coating of this metal. The process is usually done with mechanical cradles, or other forms of conveyors, but small pieces may be handled by hand.

The process was investigated in 16 establishments. Our report covers 14 establishments, located in 11 cities, employing a total of 724 wage-earners, all males. In a few instances in the state, Galvanizing is done as an independent business, but the vast amount of the work is turned out of Iron and Steel Rolling Mills. The process was very similar in all of the mills investigated.

The employers' interest in workers' welfare was very good in 11 places, while in only 1 did it seem to be quite lacking. The general type of workers was good in 8 places, fair in 3, and poor in 3. In 11 places the workers were very well retained, while in but 2 places, employing a total of less than 20 men, were they of an unsteady character. Health appliances, consisting of hoods with stacks or other arrangements to draw off zinc and other fumes, were found present in 7 places, in 4 of which they were only partly efficient, but in the remaining 7 they were entirely absent. In 5 places instructions along lines of health conservation were given to workers, and in an organized way in 3 places. In 5 places workers had the privileges of sick benefit associations. The work quarters were hygienically well constructed in 10 places, fairly so in 2 others, and not so in the remaining 2, the latter employing a total of 32 workers. Other processes found present in half of the places were: Pickling, Acid Dipping, and some Machine Shop Work. Age-group estimations summed up as follows:

Age Groups.	*No. of Wage-earners.*
Over 50 years	2
45 to 50 "	4
40 to 45 "	57
20 to 40 "	661

The *damp* character of the work was a hazard in 9 places, particularly in 1, due to the proximity of the pickling process. The *ventilation* of quarters was good in 2 places, fair in 7, and bad in the remaining 5, due to contamination with various fumes. The *heat* from the process was some hazard in 8 places, particularly in 1, while exposure to *cold* drafts when leaving the vicinity of the galvanizing furnaces and vats was another risk which a majority of the workers ran. The work may be more or less *fatiguing*. In this respect investigators commented upon the following features, arranged in descending order:

long hours, hurrying piece-work, monotonous application, constant standing, and, in one or two instances, loud noises as well as laborious work. In most places there was some opportunity of work variation. The workday was found to be 8 hours in 1 place, 8½ in 1 place, 9 to 10 hours in 5 places, 10 to 11 in 3 places, and 11 to 12 in 4 places, while night shifts were the rule in 7 of the places investigated. In 6 of these latter, two shifts made up the twenty-four hours, and in the remaining one, three 8-hour shifts were engaged. The noon recess was 1 hour in 2 places, ½ hour in 7 places, while with night shifts in the other places, it varied from "as desired" to ½ hour. The liability to the contraction of *communicable diseases* had the usual hazards as mentioned under Pickling, although they were rather less present in the places in which galvanizing was seen. The chief hazard in the process is *poisoning,* which may be due to zinc fumes (less marked than in brass founding); lead (a small amount of which is usually added to the zinc bath); to sal ammoniac (used to keep the zinc from burning); and to the fumes from the pickling processes, if located nearby. There was little risk of acute or sudden poisoning from any of these. The risk of slow poisoning was considered negligible in 1 place, fairly so in 7 more, but considerable in the remaining 6. The forms of poisoning which may be present are: "zinc chills", chronic lead poisoning (except to the person who handles lead this risk is only nominal), catarrhal trouble, due to the sal ammoniac fumes, and carious teeth as well as pyorrhea, as noted among the "picklers". The industrial inducement to *alcoholism* is about in proportion to the exposure to fumes, to which should be added the depressing effects of fatigue, long hours, lack of washing facilities, and good drinking water properly supplied.

The general *appearance* of workers was good in 6 places, and fair in the remaining. There were not many *complaints* made by workmen (few could speak English), but these consisted of the irritating effects of the fumes, as well as of "metal chills". The investigators reported specific *occupational complaints,* as follows: 3 with burns, 2 who mentioned "zinc chills", and 1 in whom the breathing of the fumes had produced chronic bronchitis. In addition, skin irritations and ulcers were brought to notice. Foremen in a number of places spoke of "chills", if the zinc got too hot.

Comments.—As stated above, only half of the places were supplied with hoods and arrangements to remove the fumes. While an endeavor is made in all places to keep temperature down, so that the zinc does not burn up, there is some escape from this in most places at different times of the day. The white fumes of sal ammoniac are constantly present. Workers should also be supplied with proper gloves, aprons, and footwear to protect them from burns and other mishaps. In some places they were found equipped with old gunny-sacks for aprons. Where lead is used, workers should be examined at intervals for any evidence of slow lead poisoning. Being hot work, change rooms, shower baths and lockers should be provided.—See, also, comment upon arsenic poisoning under "Soldering", whenever acids are allowed to act on metals.

TINNING.

Tinning or tinplating is a process in which a very thin layer of tin, often largely mixed with lead, and sometimes zinc, is applied to sheet iron, or black plate, or castings. (In some places it was said no lead was used.) Terne plate may contain up to as high as 75% lead. The process varies in different places.

The following is the usual method. Sheets from the "white pickle" are dipped (by hand or machinery) into a flux of sal ammoniac, hydrochloric acid and zinc, then into 70% lead (sometimes omitted), then into pure molten tin from which they emerge under a layer of palm oil or other oil. They are next polished and cleaned by hand or in rollers with middlings (bran), ground peanut shells, or sawdust and rags. The hand dipping is done by skilled men who use tongs to hold the sheets.

Tinning was investigated in 13 plants, located in 9 cities, and employed a total of 583 wage-earners (exclusive of "pickling", etc.), of whom 508 were males and 75 were females. The females were employed as sorters (and occasionally as polishers) to pick out the "wasters" after the tinning process was completed. The vast majority of workers were employed at the process in connection with Iron and Steel Rolling Mills, where the black plate was also made in preparation for tinning.

A union organization existed in 1 place investigated. The interest which employers took in the welfare of workers appeared to be very good in 6 places, fair in 5 more, and practically lacking in the remaining place, which also was a big employer. In 8 places an intelligent class of workers was employed, in 2 others fairly so, while in the remaining 2 they were largely ignorant foreigners. The workers appeared to remain steadily in 7 places, fairly so in 3 more, and not so in the remaining 2. Health appliances, consisting of hoods, with vents and sometimes exhausts to draw the fumes off from the tinning vats, were good in 3 places, fair in 3 more, but absent in the remaining 6. In 1 place organized instruction along health conservation lines was given: but very little attention was paid to this in the remaining 11. In 2 places sick benefit associations existed. The tinning quarters were hygienically well constructed in 5 places, fairly so in 3 more, and not so in the remaining 4. In 2 places other processes, such as pickling and polishing were carried on in the same quarters. The vast majority of workers were between 20 and 40 years of age, while a few were under 20.

Dust, dirt and disorderly surroundings, *dampness* (water, steam and humidity), *heat* (from the process itself), exposure to *cold* (by drafts and having to go to outside closets), and poor *lighting* arrangements — all of these constituted from fair to bad hazards in from ⅓ to ½ of the places investigated. General *ventilation* was good in 3 places, fair in 5 more, but poor in the remaining 4, due to contamination with the fumes of oils and greases used, and metals, as well as to deoxidation through the presence of furnaces in confined work quarters, and to the lack of means of keeping the air in circulation. In 2 places steam was excessive. *Fatigue* seemed to be a fair hazard in 5 places and considerable in the remaining 7, the chief reasons being hurrying piece-work in monotonous and straining manipulations, and less often long hours, noise, constant awkward positions, and occasionally jarring work. The workday was found to be 8 hours in 1 place, 8 to 9 hours in 3 places, 9 to 10 hours in 1 place, 10 to 11 hours in 4 places, and 11 to 12 hours in the remaining 3 places. Night shifts were the rule in several of the large places. The noon recess was 1 hour in 3 places, about ¾ hour in 6 places, and ½ hour in the remaining 3. Constant standing in the case of females while inspecting, polishing and sorting sheets of tin was also noted. Eyestrain, due to glancing of light on the polished sheets of tin, as the females turned them over, was present. The liability to the contraction of *communicable diseases* seemed a fair hazard in

8 places and considerable in the remaining 4, due to such factors as promiscuous spitting about the floors, the absence of cuspidors, the great inadequacy of washing facilities, and the little attention paid to toilet arrangements in several places, and occasionally to crowding. There was great liability to cuts and burns of all grades of severity with consequent pus infections, blood poisoning, erysipelas, etc. There was a risk of infection from rags used for polishing purposes. Furthermore, but few of the workers were under medical supervision. Practically the only females found employed in Iron and Steel Mills were in this division of the work. They were very largely immigrant girls. The *poisons* used in the tinning process were found to be lead, zinc, tin (there is a question as to this last metal's being a poison), hydrochloric acid, and sal-ammoniac fumes, in addition to the escape of fumes and gases from furnaces in some places. Some risk of poisoning existed in all places, and particularly so in 6. Those who handled lead directly, or terne plate, very rich in lead, were the most exposed, but there was some risk around the pots from the breathing of lead vapors, created by the constant stirring up of the tin-lead alloy, near which the workers were necessarily closely stationed. The risk of "zinc chills" was also present. The ignorance of the workers, the practice of using palm oil to wash the hands (thus greatly favoring lead absorption through the skin), the lack of instructions concerning the danger of lead poisoning, the lack of medical supervision, and, in several places, the great inadequacy of washing facilities, were other important factors in the risk of poisoning. The industrial inducement to *stimulantism* seemed present in practically all places and was influenced chiefly by the exposure to the poison factor, as well as heat, long hours, poor washing facilities, and fatigue, while the character of the drinking water supply was bad in some places. In others, bubbling fountains were the rule.

In all large places some workers were seen who were decidedly under par physically, but the general average was good. The *complaints* of the workers were not numerous, but consisted of poor ventilation, breathing of fumes, working in steam, lack of heat in the winter time, the loss of time from various forms of sickness, metal burns, zinc chloride burns, etc. Our investigators reported the following *occupational disease* cases: lead poisoning, 4 positive, 1 tentative; lead and zinc poisoning, 3 tentative. There were also some hearsay cases of lead poisoning. In 1 place employing only a few men, but 1 worker had remained for two years, and he stated that because of the lack of ventilation he had seen 200 men come and go in that time. Undoubtedly his statement was considerably overdrawn, but there was considerable exposure at the place. *Comments.* — Greater precautions should be taken in tining than in galvanizing because of the large percentage of lead which is customarily used. By all means should all alloy pots be well hooded and vented. Washing facilities should include shower baths for those at the hot work. We are confident that for a physician to see each worker for three to five minutes once a month, the gradual progress of slow lead poisoning, which is certainly present in a good percentage of the workers, could be prevented.

ACID DIPPING.

Acid dipping is a process preliminary to electroplating, in which metal pieces are dipped into jars or vats of acids (usually a strong mixture of the inorganic acids, HCl, HNO_3, and H_2SO_4), in order to cleanse the surfaces from

oxides and corrosive deposits, and other accumulations. The process differs from "pickling", chiefly in that acid dipping is done in cold, strong acid solutions, and smaller objects are usually so treated, while in "pickling", hot solutions of weak acidic character, sometimes with alkaline treatments as well, are used. Acid dipping is usually done by hand or some form of holder; pickling, by mechanical means. Acid dipping is a very rapid process, requiring but a moment for a dip, while pickling takes from five to twenty minutes or more in each solution.

We here report upon this process as investigated in 5 establishments, in 3 cities where it was found to employ a total of 32 workers, all males. There was a tendency to employ youths at the process, although there were 4 persons

FIG. 44. ACID DIPPING IN PLATING ROOM.
Slot ventilator along wall connected with powerful exhaust. Note slatted floor treads. Aprons and gloves furnished.

observed who were over 40 years of age. Even in the largest establishments the process requires but very few workers. It is also more or less discontinuous, as a rule. In the places investigated workers appeared to remain well in most instances. There were good health appliances in 3 plants, but these were absent in the remaining 2 where a total of 8 men were employed. In 1 place the 8 or 10 employes so engaged had the privilege of a sick benefit association, and their general care was well supervised. The work required very little skill and in 3 places a very ignorant type of workers was so employed. The work quarters were hygienically well constructed in all except 1 place. In large places the process was by itself, while in others it was usually found in a corner of the plating room, or polishing and buffing rooms.

The chief hazard is the breathing of strong, mineral acid vapors, which are created by dipping metals into such acids. In a number of instances the

vapors were clearly visible as the very poisonous brown vapors of nitroso-nitric acid. In neutralizing, vapors were also created from alkaline baths (NaOH). In plating rooms there was also the risk of potassium cyanid and other poisons used. The liability to *poisoning,* particularly from acid vapors, was considerable in 1 place, and fairly so in 3 others, due either to the absence of a ventilating hood having good draft, or to the carelessness of the workers in creating and distributing vapors, particularly where such were not plainly visible. In one place the work was done in front of an open window where the breeze drove the vapors directly towards the worker. Other hazards to acid dippers were the *dampness* of quarters, due to the vats of rinsing water, often splashed upon the floors, and the humidity from steam arising from hot water cleansing baths. All workers were found to be engaged from 9 to 10 hours, while in 3 places the noon recess was only ½ hour.

Comments. — Acid dippers should be protected by a good hood and local exhausts, or other very efficient means of confining the vapors; also with rubber gloves, rubber aprons, and perhaps rubber boots, if the work is of a splashing character at all. It must not be forgotten that a single exposure of only a few moments to breathing nitroso-nitric acid vapors, may result in pneumonia within 24 hours, or, later, to a permanent nervous affliction, characterized by constant tremors. The situation is similar to exposures which firemen suffer when carboys of acids are broken in storage rooms and other places during fires. In the recent New York disaster, in which a hundred persons or more were exposed to breathing nitric acid vapors in a sub-way accident, the subsequent death rate was over 25%, all of which followed between a few hours to a week afterwards. — See also, comment on arsenic poisoning under "Soldering" wherever acids are allowed to act on metals.

ELECTROPLATING.

The process of electroplating consists in placing the metals to be plated in a solution of an electrolyte through which an electric current is passed. The electrolytic solution is usually contained in rectangular shaped tubs or vats which stand about waist high, and the objects are hung in the solution for a period of hours. The electrolyte varies in composition according to the metal to be deposited.

The process was investigated in 43 firms in 7 cities and engaged 532 wage-earners, of whom 510 were males and 22 were females, (the latter all employed in one place where plating, buffing and coloring lead composition ornaments was done). Comparatively few employes are required for the process even in large stablishments. The industries covered were Art Glass; Automobiles; Bolts and Nuts; Brass and Bronze Products; Cash Registers; Coffins; Copper; Tin, and Sheet Iron; Electrical Apparatus; Electroplating; Foundry and Machine Shop Products; Furniture; Instruments; Regalia; Signs and Advertising Novelties; Stereo — and Electrotyping; Stoves; Safes and Vaults; and Wire Manufacturing.

In 2 of the places investigated unions existed. The employers' attitude toward welfare of workers appeared very good in 26 places, fair in 12 more, and not good in 4 places. The general type of workers was an intelligent class in 29 places, and fairly so in 10 more (not reported upon in 3). Practically all of the workers were skilled in 8 places, and a majority of them in 15 more, but in 20 plants a large percentage of unskilled workers were employed. In all

but 4 places, workers appeared to be retained fairly steadily at the process. Health appliances, consisting of hoods and vents, particularly over hot cyanide solutions, and over steaming rinsing tubs, and occasionally room exhaust fans were found present in 23 places, in 18 of which they were very efficient. They were absent in the remaining 20, in a few of which they were not needed. In 8 places some instructions were given in health precautions, but the workers were very ignorant of the exposure to poisons in most of the balance. In a like number of places sick benefit associations existed. The general construction of workrooms was hygienically good in 19 places, fairly so in 6 more, and not so in 15 (the remaining 3 not reported upon). In 21 establishments other processes were carried on in the same quarters, such as Polishing and Buffing, Lacquering and Shellacing, Acid Dipping, Enameling, Electrotype manufacture,

Fig. 45. Acid-Dipping in Plating Room.

Note ventilator over acid jars. Rubber gloves and apron furnished. Note also health placard (overhead to the right).

storage, etc. The age-group estimations summed up as follows: over 40 years, 70; under forty, 462, of whom about 10 per cent were under 20 years.

In 9 places, *dust,* which was due to the presence of other work, constituted a hazard to the electroplaters. Quarters were kept orderly and fairly well *cleaned* in all but 2 places. While *water* and *steam* are necessary features, these constituted no hazard in 20 places, and were a bad feature in only 7, where enough provision was not made for drainage from the floors, or the removal of steam from the air, or the workers were not supplied with proper clothing. Some quarters were very humid and were not supplied with foot treads or grates to keep the feet off the wet floors. Quarters were well *lighted* in 33 places, fairly so in 4 more, and not so in the remaining 6. The character of the workroom *ventilation* was fair to good in 21 places, but this

could not be said for the remaining 22. Usually, contamination with steam, vapors from the tanks, fumes from acid dipping in the same quarters and from other processes were the reasons for vitiated atmosphere. In 6 places it was somewhat warm, but this was not much of a hazard any place. Going home without changing the clothing from the wet and steamy rooms was more of a hazard than heat while at work. *Fatigue* was not found to be much of a feature in electroplating, but prolonged faulty postures, monotony, and constant standing were some feature. As a rule electroplating was diversified work. The workday was 8 hours in 9 places, 8 to 9 hours in 12 places, 9 to 10 hours in 23 places, and 10 to 11 hours in 2 places (three not reported upon). The noon recess was 1 hour in 27 places, about ¾ hour in 9, and ½ hour in the remaining 6. The risk of contracting *communicable diseases* was graded as fairly negligible in 27 places, but more or less bad in the remaining, the chief reasons being the use of common drinking cups and towels, poor closets, inadequate washing facilities, and the absence of cuspidors. In some places workers at small work were crowded together, while a large percentage of the workers were under no medical supervision. On account of wet floors and the absence of dust in most places, the risk of spreading disease through spitting was not great. The liability to *poisoning* was considered to be negligible in 10 places, fairly so in 19 more, but a quite evident hazard in the remaining 14. The types of poisons were potassium cyanide in hot solutions, acid fumes, alkali vapors, copper sulphate, and working with lead (in a few places), while fumes from other processes such as lacquering and acid dipping were frequently present. The industrial inducement to *alcoholism* or other forms of *stimulantism* was considered as negligible in 16 places, and fairly so in 22 more, but the breathing of fumes and vapor, the hot steamy atmosphere in some places, and the rather long hours, especially for young persons, were conducive to this where they existed.

The general *appearance* of the workers was on the average good in 20 places, fair in 17 more, and not good in the remaining, including one or two where large numbers of employes were engaged. *Complaints* from employes were quite numerous and were as follows: breathing acid fumes, dampness, cyanide ulcers, coughs, colds, throat trouble, nasal irritation, dizziness and headache. In some instances our investigators suffered from difficult breathing and severe headache for several hours after these inspections in plating rooms. Investigators reported a total of 8 *occupational afflictions* which they came across as follows: cyanide ulcers, 4; chronic eczema, 2; lung disease, 2. *Comments.*— On the whole, work in electroplating is not as dangerous as might be expected from the nature of the poisons which are used. An attempt should be made to keep the atmosphere in workrooms as nearly normal as possible by providing hoods and vents over hot solutions, acid dipping places, for the escape of steam, etc. While females are rarely employed at this process, in many places they were engaged in lacquering and other processes in the same quarters where plating fumes were quite noticeable. Where the processes are necessarily wet and sloppy workers should be provided with the usual means to protect themselves, such as rubber aprons, boots and raised floor tread. Gloves should be supplied for protecting the hands from cyanide solutions, especially where alkalis are also used. Personal carelessness on the part of the workers and lack of instruction are other reasons for dangers to health.

In ELECTROTYPING, the design is impressed into wax, this dusted over with graphite powder, then electroplated (usually a copper or nickel deposit is made upon the graphite), then the wax is removed and the thin metallic impression mounted on a lead back, and this fastened to a block of wood. Besides the hazards of electroplating there are those of graphite dust and lead (the latter melted in a pot, ladled out into moulds, cooled and handled).

MIXING CHEMICALS.

There is a distinction to be made between the mixing (or compounding) of chemicals and the actual manufacture of chemical ingredients. While new substances, of course, result from the mixing of chemicals, such processes are not done with the object in view of making new chemicals as products for sale. In a large number of industries certain chemicals are mixed together, or articles are subjected to chemical action, usually by a few workers, for use throughout the plant, or to make up the principal ingredients worked upon. These chemicals may be in the shape of various dry preparations or of liquids or of volatile substances. The best example of this process is the mixing of paint ingredients with various solvents and vehicles, but this particular branch, as well as some others, are so important that we take them up under separate heads. We cite here only a few of the instances in which chemicals are mixed on the grounds of the various establishments: the making of drugs, photography and photo-engraving, the preparation of inks, the grinding of dry colors, cleaning processes by chemical means, the mixing of ingredients for rubber, for enamel, paper goods, railway signals, roofing materials, glass, in the refining of oil, the making of perfumes, etc. The chief exposure to which these workers are liable are poisons, which affect primarily the respiratory and digestive systems, the skin, the eyes, and the eliminative organs. The exposures are largely the result of similar environment and methods, and may all be avoided, more or less, by the same measures.

Compounding or mixing chemicals is here summed up for 20 firms, located in 11 cities, and employing a total of 138 wage-earners, of whom 127 were males and 11 were females. In 14 of these places the methods used were modern from a mechanical point of view. In the remaining 6 they were more or less crude and obsolete. The vast majority of workers were unskilled labor of changing type, often non-English speaking, while the interest manifested in their welfare was usually as nominal as anywhere in the plants concerned. However, in this respect the general attitude toward them seemed good in a total of 13 of the 20 places. In 5 places health appliances were provided and were quite efficient. In 2 places instructions in the care of health were definitely given, while the workers had the benefits of sickness insurance associations in 3 places. The construction of the workplace, as it had a bearing upon the health of the employes engaged in the mixing of chemicals, was good in 14 instances, fair in 2 others, but bad in the remaining 4. In 7 places workers at other processes were exposed to the hazards of this as were these workers exposed to other processes. The age-group estimations for the chemical mixers summed up as follows: over 50 years, 2; between 40 and 50 years, 7; and under 40 years, 129, while probably 5 per cent of the latter were under 20 years.

Dust from the process was a negligible hazard in 7 places, fairly so in 4 more, but bad in the remaining 9. In most instances it was poisonous in

character as well as being mechanically irritating. In 11 places quarters should have been kept considerably *cleaner* in order to insure freedom from dust and fumes arising from this source. In 4 instances water, steam, *dampness,* and oils were also features, while in 2 places the *light* was very poor. There was a tendency to relegate this work to basement rooms or out-of-the-way quarters which were often quite uninhabitable when one considers that workers were supposed to spend 8 to 12 hours a day in them. In this respect some 16 places were deficient in *ventilating* arrangements so that the air was more or less continuously vitiated by one or more of the usual causes (deoxidation, contamination, pollution, stagnation, and faulty temperature-humidity relations). In 4 places workers were subject to an undue amount of *heat* while there was the often present risk of catching *cold* through going from hot to cold quarters. *Fatigue* was not a usual feature of this process, although in 2 places it was considered as a hazard. On the other hand, *inactivity* from the sedentary character of the work was a feature in 1 place. The workday for this class of workers was 8 hours in 2 plants, 8¾ to 9 hours in 4 plants, and from 9½ to 13 hours in the remaining 14 places. The noon recess was 1 hour in 1 place, ¾ hour in 6 places, ½ hour in 10 places, while in the remaining plant, in which there were two shifts working 11 hours a day and 13 hours at night, workers were not allowed to leave the plant during the entire shift. The liability to contracting *communicable diseases* was considered negligible in 4 places only. For various places the whole list of sub-factors were present. As these processes were conducted, the risk of *poisoning* seemed negligible with ordinary care on the part of employes in 4 places, and fairly so in 4 more, while, in the remaining 12, the risk was great and depended very largely upon the surroundings and methods used. It is true that in a number of these instances working conditions were satisfactory enough if employes had been informed correctly of the risks of poisoning at hand, and instructed in the avoidance of the same. This responsibility, however, was too often not assumed by the employer. Oftentimes the latter acknowledged he was not posted. The industrial inducement to *stimulantism* (principally *alcoholism*) was present in 16 places and especially so in 5, with the poison hazard as the chief cause and the other hazards of dust, vitiated air, heat, cold, etc., coming in thereafter.

The general *appearance* of chemical mixers was good on the whole in 9 places, but below par in the remaining 11, in which a total of 55 workers were concerned. The health *complaints* and complaints of working conditions by employes were, where English-speaking persons could be interviewed, varied and numerous, and usually checked up very closely with the hazards which our investigators found to be present. A number of cases of *Chronic poisoning* were discovered by our investigators among these workers. It is from this class that a considerable percentage of cases which physicians encounter in their practice are also drawn.

Comments.—Unquestionably the risk of lead poisoning is the chief one of all the poisons concerned, as lead and its various compounds are so universally used. It may be said that there are practically no lead compounds which are harmless, since it has been proven that any and all of them, commonly used in industry, are soluble in the stomach juices and hence only have to be swallowed to become a menace. After lead, benzine or naphtha was probably the next in frequency, and thereafter all manners of poisons both organic and

inorganic. Very seldom, of course, did workers suffer from acute or sudden attacks, but the characteristic of most industrial poisons is their slow and progressive action, so that it is only after we look over sickness records and death statistics for numbers of years that the appalling amount of preventable diseases, and deaths from degenerative diseases, become evident. Since 74 per cent of all trades-persons (as shown in Part II) die unnecessary deaths, it is very probable that 90 per cent of the sicknesses as well as deaths among chemical mixers are preventable. Placards, drawn up by qualified health authorities, explaining the slowly acting poisonous nature of these substances and adapted to each trade process, and explaining to foremen and employes how to avoid poisoning, should be posted up in all of these work quarters.

WOOD WORKING.

The various carpenter shop, cabinet making, pattern making, cooperage, and veneering processes, which are all that are intended to be included under the term "wood working", were investigated in a total of 50 establishments employing 2,497 wage-earners, of whom 6 were females. The analysis here given is based upon the various wood working processes in connection with the following industries: Agricultural Implements, Automobiles, Boxes, Carriages, Wagons, Cars, Cash Registers, Cooperage, Coffins, Cutlery, Electrical Apparatus, Foundries and Machine Shops, Furniture and Refrigerators, Iron and Steel Works, Oil Refining, Ship Building, Signs and Advertising Novelties, and Wood Carving.

According to the Ohio Vital Statistics report, there were 852 deaths among Workers in Lumber and its remanufacture during the years 1910, 1911, and 1912. Of this number 93 or 10.91% died of pulmonary tuberculosis. Among Carpenters and Joiners there were 2,358 deaths, of which number 221 died of pulmonary tuberculosis or 9.37%. These rates compare very favorably with that for all occupations combined for the same years which was 13.3%, and even for those engaged in Agricultural Pursuits (7.13%).

The methods observed appeared to be modern in 26 places, fairly so in 18 more, and poor in the remaining 6. The attitude toward employes appeared good in 31 places, and at least fair in the remaining, with the possible exception of one or two where large numbers of foreigners were employed. The general type of workers was fair to good in all except 2 places, while their steadiness in the plants where they were employed was generally good in 36 plants, fair in 6 more, poor in 3 (and not reported upon in the remaining 5). Health appliances, consisting of various blower systems and methods of confining dust, were good in 18 places, fair in 4 more, and absent or very inadequate in 25. In 6 of the places instructions along health lines were found. Benefit organizations covering sickness, and, in some cases, deaths, and pensions were present in 13 places. Most of the workers were skilled hands, but still a large number employed at various auxiliary processes were unskilled labor. Figures on age-groups summed up to show that about ¼ of the total employes were over 40 years of age, while only a few were under 20. Carpenter shops were hygienically well constructed in 13 places, fairly so in 14 more, not so in 17 (and not reported upon in the remaining 6). In about 1/10 of the places other processes were carried on in the same quarters, such as Painting, Machine Shopping, and various factory processes.

Dust, derived from wood, sandpaper, sanding belts, and various machines, was negligible in 6 places, a fair hazard in 15, a bad hazard in 25 (and not reported upon in 2). The floors were kept excellently clean and orderly in 5 places, fairly so in 23 more, and not so in the remaining 22. *Damp* quarters were a health-hazard in 3 places. *Light* was good in 38 places, fair in 8 more, and poor in 3. Workroom *ventilation* was good in 15 places, fair in 21, and poor in 12 places, usually due to an interior or confined location of the carpenter shop. Three places were unduly *hot,* and 2 others fairly so, due to the proximity to other heating processes, the presence of steam chambers, etc. Nine places were not sufficiently heated for winter purposes. Except for the "carpenter's stoop" and certain monotonous piece-work operations, usually requiring constant standing still, the element of *fatigue* was not found to be

FIG. 46. WOODWORKING SHOP.

Light, spacious. All dust-producing machines have a powerful exhaust system.

much of a factor in the processes. The most striking factor was the ear-splitting noises from certain ripping and planing machines. The workday was found to vary between 8 and 10 hours, the usual rule being a 10-hour day, ½ hour noons, and Saturday afternoons off. The liability to the contraction of *communicable diseases* was a considerable hazard in 39 places, the chief reasons being the absence of cuspidors, spitting upon the dusty floors, inadequate washing facilities, poor closets, the use of common drinking cups and towels, and occasionally the crowding together of workers, and dry sweeping during work hours. Medical supervision obtained in 4 plants; first-aid equipments (particularly for small cuts and bruises) were found present in most all places. *Poisoning* from the woods worked upon was found to be a complaint in 3 plants, but no alkaloidal woods were met with. *Complaints* were made of

"dust bronchitis" and, less often, of the irritating effects of dust from cocobola wood, rarely from walnut and birch. In some instances gas fumes, steam, and oak fumes from drying ovens were complained of. The presence of other processes rendered some workers liable to poisoning from ammonia, gasoline, and wood alcohol, — these in addition to Painting and Sanding. The industrial inducement to *alcoholism* was a matter of dust exposure largely, but in some 16 plants drinking water facilities were quite inadequate.

The physical *appearances* of workers were found to be good for practically all persons in 33 establishments, fairly so in 9 more, and not so in 3. A number of industrially maimed workers were seen. The chief *complaints* of the workers were the necessity of blower systems where such were not provided, and the inadequacy of some which were present; occasionally, also, the poor ventilation of quarters, inefficient heating in the winter, and the presence of fumes and vapors from other processes. In several plants all dust producing processes were found to be excellently well taken care of, the more difficult ones sometimes through the ingenuity of the workers themselves. *Comments.* — Most of the hazards above mentioned define their own preventions. As with other processes investigated, it would appear that there is great need for an engineering bureau to collect the various successful contrivances which have been made to confine dust and to make them available to all. The fact that wood dust is organic and usually non-irritating, except a few of the rarely used woods, probably accounts for the longevity of carpenters and their relative freedom from consumption. However, from one large furniture plant employing many foreign laborers, there were 9 cases of consumption reported during the last six months of the survey when an account was kept of the cases of tuberculosis among workers in that vicinity.

GLUING, PASTING AND LABELING.

The processes indicated in the title are reported upon as investigated in 8 plants, including the following industries: Manufacture of Fancy and Paper Boxes, Patent Medicines and Drugs, Printing and Publishing, Musical Instruments, Paper, Cigar and Tobacco, Regalia and Paint and Varnish Manufacture. In these 8 plants there were a total of 194 wage-earners so employed, of whom 56 were males and 138 were females. Occasionally machine methods were used, but the vast majority of the workers were doing hand work. There were no unions. The general attitude of the employers, the type of the workers, and the steadiness at work places appeared good in all except 1 or 2 places. In two places heated clothes-lockers were provided to enable employes to dry their outer garments in case of rain. In the same number of places some instructions were given along the subject of health conservation. In 1 place the workers had the privileges of an employes' benefit association. In 4 places workers were at least semi-skilled. Workrooms were hygienically constructed in 4 places, fairly so in 3 more, and not so in the remaining 1, while in the case of Cigar Making, especially, other processes were done in the same quarters. There were 18 workers over 40 years, and a considerable number, especially females, under 20 years.

The chief hazard was the licking of labels by a certain number of the employes in different industries, although they were all provided with other means of moistening them. Steaming kettles of glues and pastes produced

considerable *humidity* in some places. A number of samples of paste and glues were examined chemically, but no *poisons* (metallic) were found. Some workers, however, were associated with art work (see Printing). Instances were cited where workers were found unable to tolerate the *odors* of hot glue, particularly fish glue. In a number of places *fatigue* was some factor, due to hurrying piece-work, with monotonous and often sedentary application, faulty postures, and, in the case of machine work, jarring processes, and occasionally loud noises. In 1 place the workday was 8 hours; in 1 place, 8½; and in the remainder from 9 to 10 hours. The noon recess was 1 hour in 4 places, ¾ hour in 1 place, and ½ hour in the remaining 3. General sanitary arrangements and workroom hygiene ranged from fair to bad in half of the places investigated; they were good in the remaining. *Comments.* — (See also General Factory Processes.) Labelers run the risk of lead poisoning in paint factories where the filled and sealed cans come to them often finger-marked with fresh paint. The labelers handle the cans (some of them carelessly) and moisten their thumbs in their lips to expedite the handling of the labels. — Likewise, in the tobacco and cigar industry, it is the materials handled (usually by females) which tend to nauseate and produce digestive troubles.

PAINTING AND VARNISHING.

These two processes are usually carried on by the same workers and the terms stand for a variety of sub-processes, which include the brushing on of paint and varnish, filling, rubbing, sandpapering, staining, priming, oiling, dipping by hand or machinery, spraying, stenciling, hand decorating, striping, and polishing. Sometimes the work is associated with shellacing, lacquering, enameling and japanning, but it is not intended to include these here. The indoor painting shops (these only are considered here) were investigated in 127 establishments, located in 15 cities, and employing a total of 2,382, of whom 2,328 were males, and 54 were females. The industries in which painting was investigated were Agricultural Implements, 8; Art Glass, 5; Automobiles, 23; Bicycles and Sewing Machines, 1; Brass and Bronze Products, 2; Carriages and Wagons, 47; Cars, 8; Coffins, 3; Electrical Apparatus, 4; Enameling and Japanning, 1; Foundry and Machine Shop Products, 4; Furniture, 1; Iron and Steel Mill Products, 2; Photo Art Work, 1; Safes and Vaults, 3; Shipbuilding, 2; Signs and Advertising Novelties, 6; Regalia, 1; Toys and Games, 2; Wire Manufacturing, 1.

Ohio Vital Statistics Reports for the years 1910, 1911 and 1912 show a total of 1,025 deaths among "painters, glaziers, varnishers, and paperhangers", of which number 185, or 18.05 per cent died of pulmonary tuberculosis. The figures upon tuberculosis must be regarded as quite conservative, or too low for the class of painters and varnishers (indoor workers) which we are considering here. Also the hazards for glaziers and paperhangers (these workers could not be separated) are much less than for indoor shop painters. The above rates should be compared with the pulmonary death rate for all occupations combined during the same years, which was 13.3 per cent, and also to that for Agriculturists which was 7.13 per cent. Also with Carpenters.

Union organizations existed in 9 of the places investigated. Interest in employes' health and welfare was very manifest in 65 places, fairly so in 30 more, and only questionably so in the remaining 32. An intelligent type of

workers were employed in 93 places, fairly so in 25 more, while in 9 they were practically all an ignorant type of foreigners. Apparent endeavors were made to keep the same workers in 90 of the plants, fairly so in 17 more, while little thought appeared to be given to the personnel in the remaining 20. In a total of 17 places, various forms of health appliances were found, consisting of hoods and vents to remove fumes, vapors and dust, and to promote better ventilation in work quarters. These appeared to be efficient in 7 places, fairly so in 4 others, and not so in the remaining 6. In 110 places there was nothing present which could be so designated. In many of these, of course, the work was done in very spacious quarters so that some hazards were correspondingly less. Instructions concerning the dangers of poisoning were well given in 10 places, and fairly so in 7 more, but in the remaining 110 but little attention was given to this, and in some places very crude ideas existed concerning the methods of preventing poisoning. Sick benefit associations existed in 12 places. The general construction of work quarters was hygienically good in 39 places, fairly so in 46 more, and not so in the remaining 42. Other processes were present in about ¼ of the places, such as wood-working, machine shopping, and general factory work. Age-group estimations summed up as follows:

Age Groups.	*No. of Wage-earners*
Over 50 years	82
45 to 50 years	88
40 to 45 years	200
20 to 40 years	1,957
Under 20 years	55
Total	2,382

The work was done without the creation of *dust* and dust was a negligible hazard in 53 places but it constituted some hazard in 23 more, and a bad hazard in the remaining 51. Its danger consisted especially in its lead content. The chief source of dust was the sanding, sandpapering, or dry "rubbing down" of painted surfaces, or surfaces which had been previously lead filled. In the case of some fine work a great many coats of paint were applied on a lead priming coat, and each coat "rubbed down", or sanded by hand. Oftentimes the worker was in a confined space and unable to avoid the dust created. Very often it was impossible to control the dust and keep the worker from breathing it by any other means than the constant wearing of a respirator, to which the workers usually had violent objection. In 31 places premises were kept *clean* and orderly, and fairly so in 54 more, but not so in the remaining 42, so that the paint and dust which was allowed to accumulate constituted a hazard in these proportions. A few places kept floors clean by laying papers down before beginning work. In a total of 16 places *dampness*, due, sometimes, to location of the workroom, constituted a hazard. This was bad in 4 places. Also the process of water rubbing added to it in a number of places. Quarters were naturally well *lighted* in 104 places, only fairly so in 18 more, and not so in the remaining 5. Very often the use of naked electric lamps was depended upon for artificial lighting. Quarters were well *ventilated* in 41 places, fairly so in 45 more, but not so in the remaining 41. The reasons for poor air con-

ditions were contamination with various paint and varnish fumes, chiefly, but also the absence of air-agitators, or room exhaust fans in a large percentage of such places, or a fresh supply of air to workers in confined places (ships, cars, cabinets, vaults, etc.). Quarters were *warm* enough to be of some hazard to health in about 20 places, especially since they were constantly so. Usually, the heat was due to maintaining warm quarters to promote drying of painted and varnished surfaces. On the other hand, quarters were inefficiently heated for winter work in many places. (This does not include the painting of cars which is often practicaly out-door work.) *Fatigue* was some factor in about ⅓ of the places investigated. The reasons for this were, in descending order: hurrying piece-work, monotonous application at the selfsame movements, prolonged standing in one place, and, in a number of instances where workers were seated, no backs to the chairs or stools furnished. The workday was 8 hours in 7 places, 8 to 9 hours in 33 places, 9 to 10 hours in 62 places (and not determined in the remaining 25). The noon recess was 1 hour in 39 places, about ¾ hour in 17 places, ½ hour in 61 (and not determined in the remaining 10). The liability to the contraction of *communicable diseases* was graded in 122 places as follows: negligible, 12; fair risk, 42; bad risk, 68. The chief causes were promiscuous spitting where more or less dust existed, the absence of cuspidors, absence or great inadequacy of wash-places, poor closets, common drinking cups, and towels. Occasionally workers were closely crowded. Also wiping rags from unknown sources and unsterilized were almost universally used. The greatest hazard to health in the process is that of *poisoning*. The principal poisons found were lead (both as dust and in solution in oil and water, or spray, also "kicked up" from dust accumulations), turpentine, benzine, benzol, wood alcohol, creosote and asphaltum. In a number of the industries investigated it was claimed that no lead was used. In others lead was only used at intervals. It is well to mention that drying oils (boiled oil, etc.) often contain lead oxide as the principal drier. A physician called our attention to three cases of severe lead poisoning which he had in a father and two sons who drank some "boiled" oil to relieve constipation. Oftentimes it was impossible to determine all the poisons that might be present, in which case the investigators simply reported "paint", "varnish fumes", "paint removers", etc. However, paint removers were not very much used. Hand rubbing with oil containing a lead drier, and hand polishing with a solution containing wood alcohol (about two quarts to five gallons of mixture) were also noted. There were many predisposing causes to poisoning, the chief being the breathing of dust and sprays containing lead, and of fumes of the various volatile substances used. "No place to wash up before eating", was a common complaint. In one place six men used an old paint can to wash in. Lack of correct information on the prevention of lead poisoning, the idea, held by many, that they bore charmed lives and could not be poisoned, carelessness in eating, eating in the workroom, failure to connect up minor sickness complaints with the existence of slow poisoning, and personal carelessness — these constituted the chief hazards. The industrial inducement to *stimulantism* is considerable for practically all workers engaged in this process, due to the poison elements present, to dust, to nauseating fumes and odors, and the like. Many of these workers go without breakfast because they have no appetite for the same — a sign of lead poisoning (particularly).

The general *appearance* of indoor or shop painters was in the majority of instances below par. In this respect the investigators reported the general

average of workers not healthy appearing in a total of 68 plants. In 45 different establishments workmen were found who made various *complaints* concerning the health aspects of the processes in which they were engaged. Arranged in as nearly descending order of frequency as possible, these were: breathing of dust, breathing of fumes, lack of good room ventilation, digestive troubles, attacks of dizziness, personal carelessness, kidney and bladder troubles, and general sanitary inadequacies. Investigators reported 167 cases of *occupational diseases* as follows:

Lead poisoning, positive	90
Lead poisoning, tentative	27
Lead poisoning, partially recovered from	26
Lead poisoning, authentic hearsay cases	10
Lead poisoning, ocular	1
Benzine and Naphtha poisoning	3
Turpentine poisoning	2
Varnish poisoning	2
Wood Alcohol poisoning	1
Bleeding fingers from sanding	1
Dermatitis	2
Tubercular Bronchitis	2
Total	167

In addition to the above, there were large numbers of hearsay cases and other evidence which the Survey did not have the time to investigate further. In some old established places, foremen said that practically all workers ever employed got lead poisoning. In one large place it was said that at times there were "epidemics" of bladder and kidney troubles due to the turpentine and other solvents used. The health officer of Cincinnati, Dr. Landis, called our attention to the harmful effects of certain new paint solvents which were producing a new train of symptoms among painters.

Comments. — Dry rubbing or sanding of painted surfaces should be substituted by wet methods, or with mineral oil, to keep down the dust. Occasionally, local exhausts can be used. Where these are unfeasible, the worker should wear a tight respirator, perhaps supplied with air under pressure, while frequent change from this process to another is essential. Almost the same precautions should be taken in regard to spraying. As much needed as anything are placards informing workers how to prevent lead poisoning, and other health educational measures. Great precaution should be taken to keep quarters clean so as to prevent the "kicking up" of dust. Good washing facilities and insistence upon their use are absolutely necessary. Street clothes and lunch boxes should be kept out of painting quarters. — For vapors, fumes and gases, spacious quarters, air-agitators, local exhaust hoods, blowers and short intervals at such work are suggestions variously adaptable to various places. Finally, there is no other class of workers, from the large numbers employed to the poison factors concerned, which is more in need of a frequent medical examination than indoor (shop) painters.

In a number of instances, as for instance, STENCILING, marking, etc., harmless substitutes could be used for lead and other poison-containing paints,

and in a number of instances it was found that lead paints were being used less and less.

In a paper entitled, "The Composition of Paint Vapors" (Jour. Indust. & Engrg. Chem. Vol. VI., No. 2, Feb., 1914) H. A. Gardner, Assistant Director Institute of Industrial Research, Washington, D. C., calls attention to carbon dioxide, *carbon monoxide,* benzol, formic acid, and aldehydic substances, which may be evolved from surfaces covered by drying oil paints. All of these, of course, are toxic substances, and the author's contention that the carbon monoxide may be responsible for the peculiar type of anemia from which painters sometimes suffer is certainly a possibility. The newer forms of quick drying paints are the most likely to yield these substances. (See also Bulletin No. 41, Paint Manufacturers' Association of the U. S.) Ventilation of painting quarters, or quarters being painted, is the only means of avoiding the effects of these substances.

SHELLACING AND LACQUERING.

A shellac is a gum resin produced by an insect on several East Indian trees. The resin is dissolved in ordinary alcohol, denatured alcohol, or wood alcohol, according to its purpose. A lacquer is a thin, highly transparent varnish used to produce a thin, lustrous film on metals, etc., to preserve them against gases and vapors. The process of Shellacing and Lacquering is closely associated with Painting, Varnishing and Staining, and in many instances it is quite impossible to separate them, since the same workers may be concerned with each process. Shellac and lacquer may be brushed or sprayed on, or articles may be dipped into the solutions.

In 32 establishments, in 9 cities, employing a total of 894 wage-earners, of whom 868 were males and 26 were females, the processes of shellacing and lacquering were fairly well separated from the other processes mentioned. General conditions respecting the types of workers, health appliances, construction of workrooms and presence of other processes were practically the same as for Painting and Varnishing.

The hazards of *dust, dirt, dampness, darkness, heat* and *cold,* were all less than for Painting (warm, light rooms free from dust being a necessity). The condition of the atmosphere in workrooms was good in 14, fair in 19, and bad in the remaining 6 places, due chiefly to contamination with the fumes and vapors emitted from the process, combined with stagnation and temperature-humidity abnormalities. *Fatigue* was usually a negligible factor, except that in a few places piecework, monotony, constant standing and faulty postures were observed. The workday was 8 hours in 1 place, 8 to 9 hours in 11 places, 9 to 10 hours in 25 places, and 10 to 11 hours in 2 places. The noon recess was 1 hour in 9 places, about ¾ hour in 7 places, ½ hour in the remaining 23.

Age-group estimations summed up as follows: over 40 years, 195; 20 to 40 years, 671; under 20 years, 28. There was a tendency to employ youths of both sexes. The liability to *communicable diseases* was not quite as great as among painters because dust was not so frequent. Various *poisons* to which workers were subjected were lead (in boiled oil), turpentine, amyl acetate, wood alcohol, benzine (naphtha), benzol, toluene, acetone (?), "banana oil" and other varnish and lacquer solvents (and varnish removers).

The average *appearance* of workers was generally good in 16 places, fair in 12 more, while pallor, anemia (but sometimes very flushed faces and reddened eyes), and emaciation characterized the remaining 11 places. The chief *complaints* of workers were the effects of turpentine fumes and "varnish" causing (besides dizziness) digestive, respiratory, skin, kidney and bladder troubles. Our investigators found the following *occupational diseases* among workers:

Lead poisoning, positive	4
Turpentine poisoning, tentative	8
Benzine poisoning, tentative	2
Occupational dermatitis, positive	6
Occupational rhinitis	1
Occupational anemia	1
Occupational tuberculosis	1
Occupational nephritis	1

Comments. — See under Painting and Varnishing. It is also questionable whether females should be employed in any processes exposing them to shellac, lacquer, varnish, or polishing fumes. The same may be said of youths.

ENAMELING.

As commonly understood, an enamel is an air-drying or baking varnish to which color and opacity have been imparted by the addition of pigments (in some instances, also, of dyes). The process consists in applying enamel to steel, iron, soft metal alloys, wood, and glass in a moist or oil form with brushes, or by pouring, dipping, blowing, or spraying with compressed air, and in a dry form by sieving, dusting, or blowing the powdered enamel upon the ware. The objects are then dried and baked in a special oven, furnace or kiln to harden the enamel. Japanning was a frequently associated process. While in 3 of the places reported here, porcelain enameling of iron was done, this process itself is considered elsewhere.

Enameling was investigated in 25 establishments, in 8 cities, and employed a total of 716 wage-earners, of whom 377 were males, and 139 were females. The females were employed, chiefly, at spraying enamel. The following industries were included: Agricultural Implements, Automobiles, Bicycles and Sewing Machines, Brass and Bronze Products, Copper, Tin and Sheet Iron Goods, Cutlery and Tools, Electrical Apparatus, Enameling and Japanning, Foundry and Machine Shop Products, Furniture, Safes and Vaults, Signs and Advertising Novelties, Stoves and Furnaces, and Toys and Games.

In two or three small places very crude processes appeared to be used. There were no union organizations. The general interest of employers in the welfare of their workers was good in 19 places, fair in 5 more, and poor in 1 small place. An intelligent type of workers was employed in 16 places, fairly so in 7 more, and an ignorant class of foreigners in the remaining 2. Every attempt seemed to be made to retain the employes in 19 places, fairly so in 4 more, while in the remaining 2, little attention appeared to be given to the personnel. Health appliances consisting of hoods and vents, or work within boxes for spraying, or respirators for sanding or brushing, as well as arrangements to protect against the heat from baking ovens, were present in 13 places,

in 8 of which they appeared efficient, 4 fairly so, and 1, not so. In the remaining 12 they were absent. In 2 places, some instructions were given along the line of health conservation. In 1 place a sick benefit association existed. The work was very largely unskilled. Work quarters were hygienically constructed in 11 places, fairly so in 4 more, and not so in the remaining 10. Other processes were present in 8 places, such as the baking of the ware, japanning, decorating, electroplating, painting and factory processes. The age-group estimations summed up as follows: over 40 years; 28; under 40 years, 451, of whom about 5% were under 20 (mostly girls).

In 11 places *dust* appeared to be a negligible hazard; in 4 places there was a fair amount in the atmosphere, while in the remaining 10 it was bad. It consisted, variously, of lead compounds, fillers, sand, dried spray, and paint. It was chiefly produced by dry sanding. It was "kicked up" considerably from the floors. In many places no attempts whatever were made to control it, although here and there respirators were supplied. Especially in the dry grinding and mixing of enamels was it very dusty. Two places had these processes well hooded. Quarters were kept *clean* and orderly in 6 places, fairly so in 12 more, and not so in the remaining 7. This was especially hazardous where lead was a content of the enamels used. Dry sweeping and cleaning, sometimes during work hours, were also noted. In 3 places the work was of a *damp* character from water and sprays used, but the employes wore rubber boots, and were quite well protected. Natural *light* was very poor in 4 places. General room *ventilation* was good in 7 places, fair in 9, and poor in the remaining 9. The unhealthiness of the atmosphere was due chiefly to contamination with fumes and vapors, especially where ovens were in the same room, while stagnation of the air was a feature in several places. *Heat* was no factor in 18 places, but it was a fair hazard in the remaining 7, and especially so in 1, due to the close proximity of the baking oven. In some places *cold,* due to drafts, and having to go to outside closets or privies, and in 1 place, inefficient heating, was noted. *Fatigue* was a considerable hazard in some places and negligible in others, the former constituting, however, 16 of the total places investigated. The factors, arranged in descending order were: hurrying piece-work, constant standing (still), and, much less frequently, laborious work, long hours for the character of the work, jarring processes, pressure against the body, and loud noises. The workday was 8 hours in 2 places, 8 to 9 hours in 8 places, 9 to 10 hours in 14 places (and not reported upon in the remaining 1). The noon recess was 1 hour in 2 places, ¾ hour in 2 places, and ½ hour in 21. The risk of contracting *communicable diseases* was determined as negligible in 2 places, a fair hazard in 13 more, and bad in the remaining 10. The principal reasons for this were promiscuous spitting upon dusty floors, absence of cuspidors, inadequate washing facilities, poor closets, the use of common drinking cups and towels, wiping rags (unsterilized) from unknown sources, while in some places frequent trivial injuries, flying particles, and the short-intervaled handling of objects by different workers were factors. Among the *poisons* used in the industry, lead was not as frequently encountered as might be surmised. In only 5 places was it certainly used (red or white lead as a rule). The enamel in most places appeared to be of the newer preparations, characterized by quick drying, and free of lead. Other poisons necessarily present were turpentine and benzine (naphtha), while amyl acetate, pickling fumes, anti-

mony (?), sulphur, smoke and gas fumes were all noted. The risk of poisoning from one or another of these appeared negligible in 4 places, a fair hazard in 9, and considerable in the remaining 12. A monthly medical examination was in vogue in 1 place. The methods of doing the work, in which a large amount of dust or nebulous spray was produced were important factors in poisoning. The industrial inducement to *stimulantism* was considered bad in 3 places, and fairly so in most of the remaining, due, chiefly, to the poison factor, after which the question of dust, poor ventilation and fatigue entered.

The general *appearance* of enamelers rated good in 11 places, fair in 12 more, and poor in the remaining 2, the latter including a total of 30 persons. In a number of instances, pale and anemic looking workers were seen. The health *complaints* of workers were the breathing of fumes, sprays and dust, the frequent failing of the special ventilation systems used, and subjective symptoms of the effects of the above hazards. In a number of places dizziness was a frequent complaint. Investigators reported the following instances of *occupational disease*: lead poisoning, 4 positive, and 1 tentative; dermatitis from naphtha, 1 positive; while there was considerable additional evidence of the effects of turpentine and benzine fumes, as well as further instances of lead poisoning.

Comments.—Where lead is used, a monthly examination of all exposed employes should be made by a physician. Installation of hoods and vents, or the performing of the work within enclosed cupboards or boxes, through which the hands may be inserted, and, where these are impractical, the insistence upon the wearing of respirators, and a frequent interchange of workers should be instituted. Every case of sickness among enamelers should be investigated by a factory physician, with a view to eliminating the cause (not the worker).

JAPANNING.

A japan is a lustre-giving substance containing resins or gum-resins, metallic salts, drying oils, and volatile liquids; or (decorative japan) asphaltum, etc., and lies between a spirit varnish and an enamel. Japanning is a process closely associated with enameling, the substances being applied in much the same way and baked.

The process was investigated in 10 establishments, in 6 cities, and employed a total of 146 wage-earners, 89 of whom were males and 57 were females. General working conditions, type of workers, retention, health appliances, construction or workrooms and the presence of other processes did not differ materially from those described under Enameling.

The following hazards were considered bad in the number of places mentioned: *dust,* 1; *dirt* and *disorderliness,* 2; *darkness,* 1; poor *ventilation,* 3 (and in 5 others only fair); *heat,* 1; fatigue, 5 (due to hurrying piece-work, constant standing and monotony); liability to *communicable diseases*, 6 (the same factors as under Enameling); and industrial inducement to *stimulantism,* a fair extent in most places.

Age-group estimations showed 36 over 40, and 5 under 20, the remaining 105 being between 20 and 40 years. The *poisons* used in the process, so far as could be learned, were turpentine, benzine (naphtha), "japan," and bronze. There were in places also the escape of gas fumes from the baking ovens. The liability to poisoning was considered negligible in 2 places, fairly so in 5 more,

but considerable in the remaining 3. In places the workers dipped their arms up to the elbows in the solutions.

The general appearance of workers averaged good in 6 places and fair in the remaining 4. There were some pale, anemic looking individuals, and others who seemed below par in health. *Complaints* were not frequent, but the effects of fumes and urinary trouble were brought to the attention of investigators. At one place one man had quit because of this urinary trouble. *Comments.*— (See Enameling) The tendency of many workers to wash their hands in benzine was noted in both this process and that of Enameling.

BRONZING AND GILDING. — These two processes were frequently seen in connection with other decorative work in many industries. Usually females were employed. Very thin sheets of bronze aluminum, and other gilding materials were applied or stamped on with a "size", consisting of thin varnish or a similar solvent, while, other times, these gilds were brushed on from a mixture of them in benzol, acetone, pyroxylin, wood alcohol, amyl acetate or gasoline, and occasionally ammonia, or were sprayed on (in which case a hood and exhaust were used). Again, bronzing or gilding machines, equipped with large gas burners, were usually unvented, and a source of deoxidation and contamination of the quarters in which they were located. None of these "bronzes" were analyzed for lead or arsenic (which they sometimes contain), but no cases of metallic poisoning were discovered among the few workers seen.

LITHOGRAPHING.

This process was investigated in 10 establishments, in 5 cities, and in connection with the following industries: Printing and Publishing, Copper, Tin and Sheet Iron Goods, and Signs and Advertising Novelties. Different methods of designing, photographing, etc., upon stone, zinc, aluminum and other surfaces, as well as press work, are here included.

There were a total of 539 employes so engaged, of whom all but 14 were males. One plant was exclusively a union shop. The work was very largely skilled, the type of workers good, and they appeared to remain at the same places of work to a large extent. There were no benefit organizations, although in 1 place instructions along health lines were given. There were no special health appliances in any place. The general construction of work quarters was good in 5 places, fair in 2, and poor in the remaining 3, while other processes were present in 6 places, such as printing, stenciling, engraving, embossing, and the like. There were a total of 50 workers over 40 years of age, 483 between 20 and 40, and 6 under 20 years.

Environmental conditions were graded as follows: a fair amount of *dust* in 6 places; *disorder* and *dirt* in 1; in 2, *light* only fair; in 2, quarters overly *warm;* and in 8, risk of contracting *communicable diseases* from the promiscuous spitting upon floors, absence of cuspidors, inadequate washing facilities, and the use of common drinking cups and towels. *Fatigue* was a fair hazard in 5 places, due to constant standing, monotony, piece-work, eye-strain and loud noises (from presses). Litho-engravers, designers and artists had the same hazards as elsewhere described. The workday was from 8½ to 9 hours in 3 places, and from 9½ to 10 hours in 7 places, while the noon recess was 1 hour in 4 places, ¾ hour in 1, and ½ hour in the remaining 5. In 1 place a night shift of 12 hours was maintained, while overtime work was some feature in other places. The general *ventilation* of workrooms was good in 3

places, but fair to bad in the remaining 7, due, somewhat, to contamination from gas, fumes and vapors, but, mostly, to stagnation of the air. Occasionally pollution from city smoke in the quarters of upper floors was frequent. The chief *poisons* in connection with the process were found to be the various colors, inks and greases used (but, except for skin affections, the risk from these sources did not appear to be great, especially for the class of workers employed), turpentine fumes, benzine and, occasionally, anilin used in cleaning, and nitric acid in spray "cutting" of plates, which in one place turned that part of the worker's hair, which was exposed, red-brown in color. The risk to the workers from poisoning appeared to be negligible in 6 places, but a fair hazard in the remaining 4. Nauseating *odors* from rosin, inks, and fumes were marked in some places. The industrial inducement to *stimulantism* was principally a question of the depressing influences of the air in the workrooms, to which the poison factor should be added.

The general *appearance* of workers was good in all places, while there were no special *complaints* made, except as related to ventilation, and occasionally to sanitary inconveniences. *Comments.* — (See Printing — Art Work, Press Rooms). In some instances it would seem advisable to put a hood and vent over the lithographing presses.

UPHOLSTERING.

This process is an auxiliary one in certain industries. We here report upon it as performed in 3 automobile plants, 6 carriage plants, and in 5 furniture plants. In these 14 plants there were found to be employed at upholstering a total of 304 wage-earners, of whom 219 were males and 85 were females. Apparently modern methods were the rule in 12 places. There were no labor organizations. An intelligent type of workers was employed in 12 places, fairly so in 1, and largely non-English speaking foreigners in the remaining 1. The attitude towards employes seemed excellent in 10 places, fairly so in 2, and not so in 2. Health appliances to remove or confine dust were absent in all places, but occasionally respirators were furnished. In but 1 plant were the workers protected by a sick benefit organization. All workers were skilled in 2 places, a fair percentage were so in 3 places, and the majority unskilled in 9 places. There were 33 of the total number who were over 40 years of age, and 5 who were under 20 years. Work quarters were hygienically constructed in 4 places, fairly so in 5 more, and not so in the remaining 5. In half of the places other processes were carried on in the same room, such as painting and varnishing, packing, and various factory procedures. Also these workers were apt to be doing other things than upholstering at times. Retention of workers was good in 10 places, fair in 3, and not so in 1.

The work was so performed that *dust* was a negligible factor in 4 places, a fair hazard in 3, and more so in the remaining 7. Its composition was principally excelsior, hair, hay, flax, tow, moss and vegetable fiber. Quarters were *clean* in 4 places, fairly so in 6, and not so in 4. *Humidity* was no factor. On the other hand, the dust tended to keep the *air* excessively dry in numbers of places. *Light* was good in 12 places, fair in 1, and poor in 1. General room *ventilation* was good in 4 places, fair in 7, and poor in 3. Often this was influenced by paint and varnish fumes from other processes, and faulty heating appliances. *Heat* is not a feature of the process, but inefficient heating was

found to exist in 4 places. *Fatigue* was no hazard in 5 places, a fair hazard in 8 places, and considerable in 1, due to hurrying piece-work, monotony, constant standing, and occasionally some eye strain. The work day was between 8½ and 9 hours in 7 places, and 9 to 10 hours in 7 places; the noon recess was 1 hour in 5 places, ¾ of an hour in 5, and ½ hour in 4 places. The risk of contracting *communicable diseases* was fair in 5 places and bad in the remaining 9, due to such factors as crowded quarters, promiscuous spitting, absence of cuspidors, dry sweeping, common cups, inadequate wash-places and closets, lack of physical examination and medical supervision. Animal *infections* from the *materials* handled were not found. *Poisons* are not used in the process properly, but in some places workers were exposed to paint, varnish and wood alcohol, needlessly. Inducement to *alcoholism* and stimulants was negligible in 6 places, fair in 5, and bad in 3, due to inadequate drinking water facilities, lack of interest in employes' welfare, the irritating effects of dusts inhaled and swallowed, and other depressing influences as mentioned.

Appearances of the workers were generally good in 12 places, but in the remaining 2 several were observed who seemed out of health. The *complaints* of workers were the irritating effects of the fine dusts breathed, more pronounced in the case of certain mosses and hairs. *Comments.* — This being a dusty occupation of difficult control, all persons entering it should be physically examined first, and medically supervised at intervals thereafter, and should use some form of a light respirator whenever the work produces sneezing or coughing.

According to the U. S. Mortality Statistics Report (1909) there were 327 deaths among Upholsters, of which number 65, or 19.8%, died of consumption.

SEWING.

The process considered is that of sewing machine operations, although some few hand workers are included in the totals of employes mentioned. The process was investigated in 26 establishments, in 7 cities, and employed a total of 4,205 wage-earners, of whom 793 were males, and 3,412 were females. The different industries covered were: Clothing (including men's and women's garments, mittens, and underwear), Regalia, Hats, Mattresses, Shoes (cloth processes only), Mittens, Fur Goods, Bags, Coffins, and Automobiles (trimmings).

Mortality Statistics including pulmonary tuberculosis for this class of workers have been considered under the subject of Clothing and Textile Manufacturing (Part IV.).

The general methods pursued were about the same everywhere, irrespective of the nature of the goods worked upon. Unions existed in 3 establishments. The employers' interest in workers' welfare seemed very good in 18 establishments, fair in 6 more, and poor in 2 places (employing a total of 150 females). The general type of workers consisted of an intelligent class in 20 places, fairly so in 3 more, while a large percentage of non-English speaking foreigners (girls) were employed in the remaining three. Every endeavor seemed to be made to keep the same employes in 22 establishments, fairly so in 3 others, while 1 establishment, employing a total of about 350, paid very little attention to the personnel, who seemed to be constantly changing. Health appliances, consisting of mechanical means to promote ventilation,

were good in 5 places, but practically absent in the remaining 21. Some establishments, in addition, had excellent rest rooms, change rooms, restaurants, lockers, nurses in charge, and physicians in easy call, etc. In 5 places organized instructions in health conservation were being given. In 3 places sick benefit organizations existed. About half of the total workers were skilled help. The construction of work quarters was hygienically good in 17 places, fair in 3 more, and not good in the remaining 6. In 8 places other processes were carried on in the same quarters with sewing machine processes, such as pressing, cutting and hand-work. Age estimations summed up to show that there were 514 over 40 years of age, and 3,691 under that age, of whom probably 25% were under 20 years.

Fig. 47. Model Sewing Room in an Underwear Factory.

Note air-agitators of the draftless type over the workers' heads to prevent stagnation, — the chief hazard in ventilation. Also swing windows for use in fair weather. Also the excellent lighting system, arrangement of workers sidewise to light, chairs with backs, etc. Such conditions increase production because they insure health and happiness.

A certain amount of fiber and textile *dust* is created by the running of cloth through sewing machines, but in 17 places this appeared to be very small in amount, while in the remaining the character of the goods handled seemed to create a good deal of *dust,* enough to make it a considerable hazard in at least 6 places, employing a total of about 775 workers. It was composed of hemp, cotton, wool, leather, polish, hair from furs, etc., according to the nature of the goods worked upon. In some places the workers were covered with this lint and dust and coughed almost constantly. General cleanliness of *quarters,* which included the frequent cleaning of floors to collect up dust and lint, was

good in 17 places, fair in 6 more, and bad in the remaining 3. Dry sweeping or brushing up during work hours was a fairly common observance. Natural *light* was good in 18 places, fair in 5 more, and bad in the remaining 3, one of which employed about 225 workers. In a considerable number of places, artificial lighting was by naked electric lamps, so placed that they were very damaging to the eyesight of the workers because of the direct light into the eyes. In numbers of places, workers were seated facing windows and other sources of light, while attention was given to seeing that light arrangements were perfect in other places. Light window shades helped materially. The general *ventilation* of working quarters was good in 15 places, due either to general spaciousness of quarters, or to mechanical means of promoting the circulation of the air; it was fair in 6 more, and bad in the remaining 5 (where a total of about 500 workers were employed). *Heating* arrangements were usually good, although there was a general tendency to keeping room temperatures too high in the winter seasons, which, combined with the excessive dryness of the air (see discussion upon Humidity in Part III.) was depressing and predisposing to lung troubles. One place, employing 120 girls up next to the roof, was very warm and close. The chief hazard in this work is *fatigue*. Practically the whole gamut of fatigue factors were found to be active, different ones varying in prevalence in different places. In descending order of importance they were: "bowed over" postures; hurrying piece-work; evidences of speeding up; monotonous application and concentration; eye-strain (in one large place 51% of girls wore glasses; probably many more needed them); loud noises; long hours; chairs and stools without backs; prolonged straining movements; jarring and jiggling of certain forms of machines; and here and there laborious work, constant standing, and using the body to press constantly against objects. The workday was found to be 8 hours in 1 place, 8 to 9 hours in 6 places, and from 9 to 10 hours in the remaining 19. The noon recess was 1 hour in 12 places, ¾ hour in 1 place, and ½ hour in the remaining 13. Overtime was very seldom resorted to (laws governing the workday for females prevent this beyond the 10-hour limit). As the work is very sedentary, most of the muscles and nervous mechanisms of the body are out of function a great part of the time, so that autotoxemia, due to sluggish circulation, is an added factor to the fatigue toxins produced in the parts used. In other words *inactivity* is a very potent principle in the diseases of this class of workers. In a number of places this was recognized, and work variation such as the requiring of employes to get up from their seats and secure their own working materials and to deliver the finished goods were resorted to. (A short recess twice a day would help immensely). Furthermore, in some places gymnasium and outdoor recreative features were supported. The liability to the contraction of *communicable diseases* was something of a hazard in all places, although pretty well guarded against, in at least 6 establishments. In one place the whole building (5 floors) was fumigated twice a month with sulphur — a pipe system distributing the fumes. In 7 others, also, no more than the usual risks of indoor workers appeared to prevail. In the remaining 13 the hazards seemed considerable. The principal factors were the presence of a large number of persons more or less crowded together in the same rooms, the use of common drinking cups, roller towels, dressing rooms without individual hooks or lockers, and in numbers of instances inadequate washing facilities, as well as other sanitary inconveniences. In a number of places where men were em-

ployed in large numbers there was considerable spitting upon the floors, and a general absence of cuspidors. The short intervalled handling of objects by different persons was also a feature. In but 3 or 4 of the larger places were physical examinations required of new employes, while, as our case records show elsewhere, numbers of consumptive workers were at work in the midst of the others without any provisions for meeting the situation. The only *poison* to which workers were found subjected was the use of benzine or naphtha in association with other processes (cleaning, cementing) carried on in the same quarters. The industrial inducement to *stimulantism* existed in the prevalence of two causes chiefly — fatigue and inactivity.

The general *appearance* of the workers was contented, happy, and on the whole fairly healthy in 14 establishments, but somewhat less so in all these respects in the remaining 12, in which about a half of the total employed were found. Employes, as a rule, made but few *complaints.* Those heard consisted of eye-strain, headache, backache, lack of recess intervals, dust (especially in mattress and sack or bag factories), poor ventilation, "killing pace" at which it was necessary to work to make a living, coughs, colds, and the like. It is necessary to say that only a very few workers were interviewed personally.

Comments. — As the consumption rate is high among this class of employes, managements should give special attention to the hazards mentioned above, and make arrangements for a medical supervision which will provide, early enough, for the removal and proper care of consumptive persons, and a general protection of the balance. Physical examination of new employes should be insisted upon, including the eyes. Nystagmus, or dancing pupils, is said to affect one-fourth of all sewing machine operators, due to strain of the eyes in following the stitch through the cloth.

IRONING AND PRESSING.

This hand process requires no special description. It was investigated in 21 establishments, representing such industries as Dry Cleaning and Dyeing, Regalia, Hats, Textiles, and Clothing Manufacture. (The process in laundries is considered elsewhere.) There were 570 employes so engaged, of whom 396 were males and 174 females. In all but 3 places modern methods were used. No union organizations existed. The attitude toward employes appeared good in 18 places, fair in 2 and not so in 1. Although a large percentage of foreigners were employed, they were of an intelligent type in 18 places, and remained well at the work in the same number of places. Health appliances, in the nature of room exhaust fans, air agitators, and hoods over large work, were good in 1 place, fair in 5, and absent in the remaining. In but 1 plant did a sick benefit association exist. The work is semi-skilled. There were 120 workers over 40 years of age, 433 between 20 and 40, and 17 under 20. The construction of work rooms was hygienic in 14 places, fairly so in 5, and not so in the remaining 2. Other processes were present in 5 places, such as sewing, cutting, printing, and factory work.

Dust was no feature of the process. Quarters were well *lighted* in 17 places, fairly so in 1, and not so in 3. General room *ventilation* was good in 8 places, fair in 9, and bad in the remaining 4, due principally to still, "dead" air, incomplete oxidation of gas burners for heating, and absence of methods to renew the air. *Heat* was a negligible factor in 13 places, fairly so in 5, and

bad in the remaining 3. It is difficult to find a more *fatiguing* procedure than hand ironing or pressing when such is the operation constantly pursued day after day. The number of persons with fatigue neuroses, particularly affecting the arm used, which appear at dispensaries and hospitals attest to this. Oftentimes there is added neuritis and partial paralysis. In the plants investigated fatigue was a bad hazard in 6, fair in 8, and about negliglble in the remaining 7. The chief factors were hurrying piecework, monotony, constant standing, constant strain, stools (where used) without backs, continued faulty postures, jarring processes, and constant pressure against the body. The workday was 8 hours in 1 place, 8½ to 9 in 11 places, and 9½ to 10 in 9 places; the noon recess was 1 hour in 9 places, ¾ hour in 2 places, and ½ hour in 10 places. The liability to *communicable diseases* was bad in 6 places, fair in 12 and negligible in 3, due principally to overcrowding (irrespective of room space), absence of lockers or clothes rooms, common towels and cups, poor washing facilities and closets, promiscuous spitting, absence of cuspidors, and the handling of articles which, in some places, might carry infection. There seemed to be a rather doubtful moral tone in some places employing both sexes together. Medical supervision was good in 3 places, but absent in the balance. The liability to *poisoning* was a negligible factor in 17 places, but in the remaining 4 it was fair to considerable. The dangers were escape of unburned gas fumes, the use of gasoline or naphtha in the same quarters (unventilated), and, in 1 place, of wood alcohol which workers used, even, to wash their hands. The inducement to *stimulantism* was in direct proportion to the extent of the hazards above mentioned.

The general *appearance* of workers was fair to good in 15 places, and not so in the remaining 6. The chief *complaints* of workers were hot workrooms, gas odors, steam and dampness, fatigue effects, rheumatism, and "nervous breakdowns". *Comments.* — Outside of the usual ventilation and sanitary requirements, considerable thought should be given to varying this process and limiting piecework, speeding up, and constant standing.

JUNK.

The workers in junk sheds and warehouses are engaged in the sorting of waste, rags, paper and metal. Occasionally non-ferrous metals (especially lead) are melted down, much as in brass founding, and cast into ingots or pigs to be sold.

Our investigations covered 25 establishments (exclusive of paper manufacturers) located in 5 cities employing 350 wage-earners divided as follows:

Process.	*No. Establishments.*	*Males.*	*Females.*	*Total.*
Paper and Rag Sorting	20	203	71	274
Refining Metals	4	33		33
Waste Mfg.	1	158	10	168
	25	394	81	475

Age-group estimations summed up 50 males and 26 females over 40 years of age. There were a few under 20. There were 2 places, including the waste

works, which had improved methods for handling materials. There were no unions. The attitude toward employes seemed bad in 6 places, and but fair in 7 more. A class of ignorant foreigners were employed in 17 places, while retention at the work seemed poor except in 4 places. Health appliances, consisting of dust removal systems locally applied and hoods with exhausts over metal pots, were present in 2 places, but in 1 of these very inefficient. There were no instructions or health placards in any of the establishments including those which brought the workers in contact with poisonous metals and fumes. None of the workers were industrially insured against ill health. There was no skill required in the processes. Work places were hygienically constructed in 2 instances only, while there was little attempt anywhere to separate various sub-processes.

The exposure to *dust* was a bad hazard in 17 places, its source being the rags, paper and metals handled. Quarters were very *dirty* and disordered in 19 places, while a fourth of the places were practically unprotected from the weather. The *light* was very poor where the workers were engaged in 8 places. Confined quarters giving poor opportunity for *ventilation* constituted a bad hazard in 13 places, and fairly so in 3 more. *Heat* was a bad hazard in 1 place employing 10 men. Chilling from winter *cold* was a hazard to the workers in ½ of the places. In one place employing 17 men and women the only heat was from unhooded salamanders, the gas from which filled the quarters. *Fatigue* was a considerable hazard in at least 3 places employing girls, due to absence of seats, piece-work, faulty postures, and the like. In 1 place 3 females were seen seated upon the floor, there being no chairs nor stools provided. The workday was found to be 8 hours in 1 place employing 12 persons, of whom 9 were females, but was 10 hours or longer in all the rest where reports could be obtained. The noon recess was 1 hour in 5 places, ¾ hour in 1, ½ hour in 10 places, and no regular time taken in the balance. How much overtime was put in could not be ascertained. The liability to the contraction of *communicable diseases* was great in 18 places, fairly so in 2 others, negligible in 1 more, and was not definitely reported upon in the remaining 5 places. The chief hazards, besides the handling of the materials, were inadequate or absent wash-places and closets (occasionally the same closet was used by both sexes), promiscuous spitting, absence of cuspidors, and lack of any medical supervision. *Poisoning* was a great hazard to 85 workmen in 10 places where lead and soft metal alloys were handled and smelted. In 1 place 5 tons of lead were melted at a time. The likelihood of "brass chills" was slightly less than in brass foundries. The work was done by ignorant workers who received no instructions as to dangers, were generally without washing facilities, and ate their lunches while at work. Hoods to remove fumes from melting pots were absent in all except 1 place, but a few of the places had the melting pots outdoors. The industrial inducement to *stimulantism* was of course great in all places where dust, depressing surroundings, poor heating arrangements and poisons existed along with the absence or inadequacy of drinking water facilities. There is a question also of the propriety of employing both males and females together in the sorting of old rags, etc.

The general *appearance* of workers was fair to good in 10 of the plants (none, however, engaged in handling metals). The workers, as a rule, were very reticent about making complaints, but the ill effects of dust, insanitary quarters and long hours were complained of by them. Our investigators discovered 4 *cases of lead poisoning* in 2 smelting plants, 2 cases of tuberculosis,

and the report that several cases of lockjaw had come from 1 of the large plants.

Comments.—Where metal melting pots are placed indoors they should be properly hooded and vented. The grinding and beating of rags and paper should have dust confining or collecting systems. (These were observed in 1 place.) We were unable to make an intensive study of the possibility of infectious and contagious diseases among the workers who were handling rags and materials collected from all sorts of places, but in this connection an outbreak of smallpox in a manufacturing establishment was laid to the use of old rags bought for cleaning machinery. Of all workers these should have the best of sanitary conveniences as well as first-aid remedies for cuts, punctured wounds, burns and the like.

SPECIAL PROCESSES.

PRINTING. — COMPOSING ROOMS AND GENERAL JOB WORK.

This was invesitgated in 26 establishments, in 12 of which it was more or less of an auxiliary feature. The lines of business were printing and publishing, manufacture of boxes, art, glass, painting and varnishing, paper goods, matches and electrotyping. In these places there were employed a total of 513 wage-earners of whom 385 were males and 128 were females. Methods

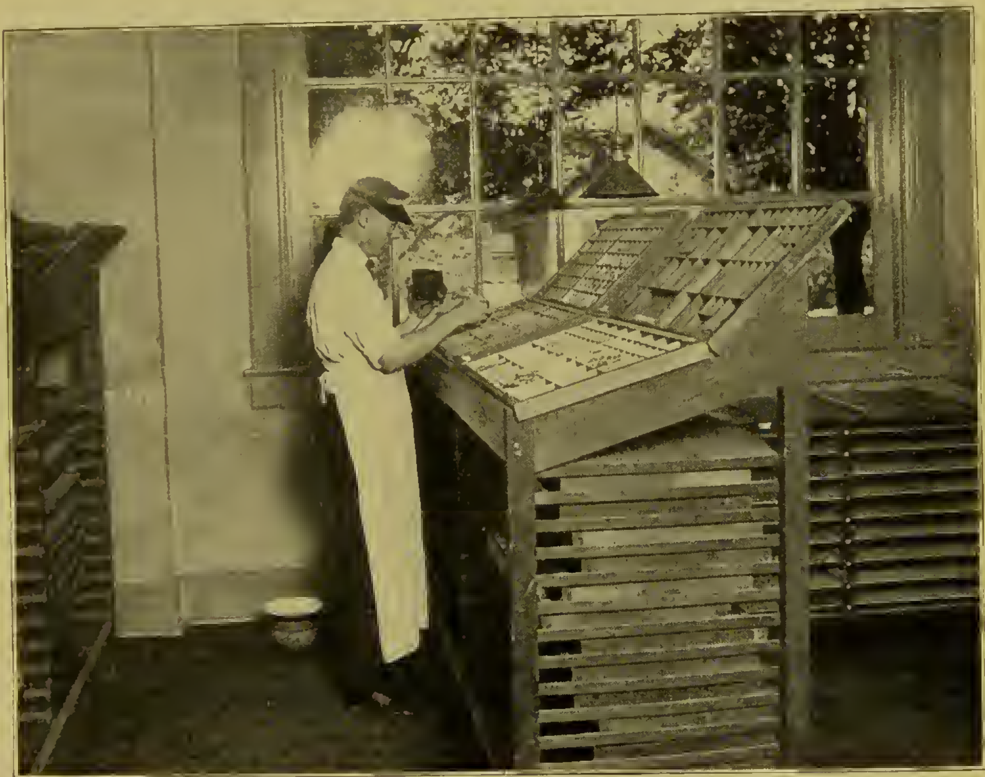

FIG. 48. PROPER ARRANGEMENT OF WORKMAN TO LIGHT.
Note shaded lamps, eyeshield, also convenient cuspidor. Many less skilled workers do just as tedious eyework under exactly opposite conditions.

were considered modern in 18 places, fairly so in 5 and crude in 3. Labor organization existed in 9 places. The attitude toward employes was good in 20, fair in 4, and bad in 2 places. The employes were an intelligent type in 20 places and the majority only fairly so in the remaining 6. Employes were well retained in 21, fairly so in 1 and not so in 4 places. Instructions along health lines in the form of placards were found posted about, in 4 places. In

none of the places were benefit organizations existing (union printers excepted). The workers were all skilled in 13 places, fairly so in 7 more and largely unskilled in the remaining 6. There were a total of 67 employes over 40 years of age, 424 between 20 and 40 and 22 under 20. Work rooms were hygienically constructed in 13 places, fairly so in 4 and bad in 9. Other processes in the job printing room were numerous and found to exist in about ⅓ of the places.

Dust was a fair hazard in 10 places, bad in 1 and negligible in the remaining. Quarters were kept *clean* in 14, fairly so in 9 and not so in 3. Dry sweeping and dusting of fonts with an air blast are pernicious. *Cold* and *dampness,* due to inefficient heating, were found to exist in 4 places. *Light* was good in 17 places, fair in 4 and poor in the remaining 5. General room *ventilation* was only fair in 10 places and bad in 7 more. *Fatigue* seemed a negligible factor in 8 places, fair in 10 and bad in the remaining 8, due, principally, to hurrying piece-work, monotony, constant standing, strain, chairs and stools without backs, faulty postures and in some cases jarring processes and loud noises. Eyestrain and myopia are special hazards of the printer and every such worker should be assured of the condition of his eyes for such work. The workday was found to be 8 hours in 13 places, 8½ to 9 in 5 places, and 9 to 10 in 8 places. The noon recess was 1 hour in 3 places, 45 minutes in 7 and ½ hour in 16. Overtime was rarely done. The risk of contracting *communicable diseases* was negligible in 10 places, fair in 6 and considerable in the remaining 10, due, principally, to promiscuous spitting, absence of cuspidors, inadequate washing facilities and closets, common cups and towels and less often to crowding, common handling of objects, and trivial injuries. Adequate medical supervision was universally absent. While the risk of *poisoning* was largely a question of personal hygiene (avoiding dust and holding the type in the mouth), still in ⅝ of the places certain conditions favored poisoning; such as, lack of instruction, workers' ignorance, inadequate washing places, eating while at work and in the workroom, absence of lockers, dry sweeping, and lack of ventilation for fume-producing processes. The poisons noted were lead, analin oil, benzine, carbon dioxide, fuel gas, type dust (which also contains antimony), bronze powders and paraffin fumes. An industrial inducement to *alcoholism* and stimulants was a fair hazard in 18 places, especially so in 5, due to inadequate drinking water facilities combined with the depressing influences above mentioned.

The general *appearances* of employes were good in 19 places, while in 7 a certain number of pale, sickly and presenile persons were seen. The chief *complaints* of workers were poor room ventilation, fumes, type-dust, risk of lead poisoning, and working along with supposedly tuberculous fellow-workers. One case of lead poisoning was seen, and another case of the same complaint which was tentative. Lead poisoning which occurs in this process is usually of very slow progressive character, producing hardened arteries, enlarged heart and apoplectic strokes. *Comments.* — While 6 plants visited were models in sanitation and ventilation, the majority need attention given to still, "dead" air, especially in which free gas flames are present. Especially, is a vacuum cleaner to be used in type-font rooms. The hazards mentioned above suggest other features to be remedied.

PRINTING. — TYPE MACHINES.

This class of procedure includes all processes in which type metal is melted and used, such as linotyping, monotyping, and stereotyping. (Electrotyping is practically identical with electroplating, *q. v.*) These are here reported upon as the results of our investigation in 15 plants. The total wage-earners so employed was 361, of whom 348 were males and 13 were females. Seven of the places were union shops. The general attitude toward employes was good in 12 places, and at least fair in the remaining. The workers were

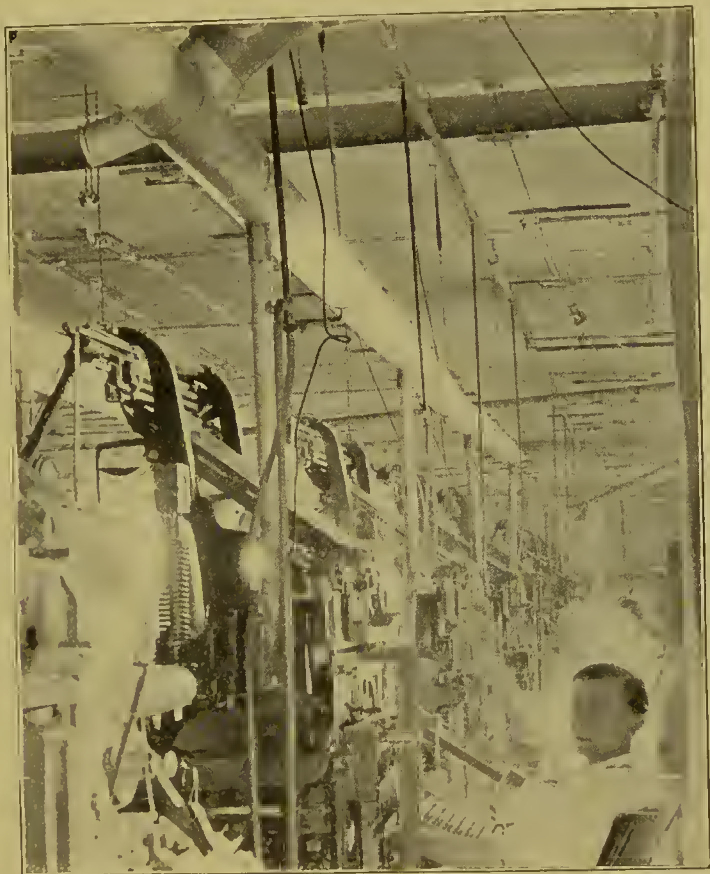

FIG. 49. LINOTYPE ROOM. SHOWING SYSTEM WITH CONNECTIONS TO EACH METAL POT AND BURNER. THE WHOLE SYSTEM IS CONNECTED TO A TALL CHIMNEY STACK. IN ADDITION THE ROOM HAS TWO LARGE EXHAUST FANS TO PROMOTE AIR CIRCULATION.

of intelligent type in all places, except here and there a few non-English speaking laborers. Retention of workers was good in 12 places, fair in 1, and not so in 2. Health appliances, such as hoods and stacks over metal pots, furnaces and burners, were good in 5 places, fair in 2, and absent in the balance. In 3 places there were sick benefit associations. In 12 places the mass of the workers were skilled, and in the remaining, unskilled. There were 52 employes over 40 years of age, 295 between 20 and 40, and 14 under 20. The

workrooms were hygienically constructed in 6 places, fairly so in 4, and not so in 5. In 4 places, other processes were carried on in the same quarters, such as press work, hand type-setting, etc.

Except in electrotyping, *dust* is not a feature of the process, although in several places there was some dust in the air. Dirt and waste *accumulations* were well taken care of in but 2 places, and were not a bad hazard at any place. Inasmuch as lead is in high percentage in the type metal used, greater *cleanliness* should have been the rule in 13 places. *Dampness* is not a feature of the process. *Light* was good in all but 2 places, where it was poor. General room *ventilation* was good in only 1 place (which had all machines piped and exhaust fans in the windows, while in 6 places it was decidedly bad. The chief features were the escape of gases and fumes from the hot processes, absence of air-agitators and means of renewing the air. *Heat* was a negligible

FIG. 50. RECOVERING TYPE METAL.

This melting process should always be done in a separate room.—Type metal pot covered and fairly well flued.

factor in 7 places, a fair hazard in 7, and bad in 1. *Fatigue* was not found to be any particular hazard any place. The work day was 8 hours in 11 places, and from 8½ to 10 hours in the other 4. The noon recess was 1 hour in 4 places, ¾ hour in 5 places, and ½ hour in 6. The risk of contracting *communicable diseases* was negligible in 2 places, fair in 6, and considerable in 7, due, principally, to promiscuous spitting, absence of cuspidors, inadequate wash-places and closets, common towels and cups, occasionally crowding of workers together, with lack of medical supervision. Industrial *poisoning* was quite negligible in 4 places, a fair hazard in 4, and a considerable hazard in 7, due, chiefly to the absence of hoods and vent pipes over metal pots, and especially over gas burners and furnaces; also to absence of proper washing facilities. A chief feature was the habit which some workers had of continually stirring up the surface of the molten metal by dropping in slugs and waste metal at

frequent intervals, thus permitting the fine sub-oxide of lead dust, as well as antimony vapors, to escape. Industrial inducement to *alcoholism* and stimulants was a fair hazard in 10 places, due, principally, to the depressing influences cited above, rather than drinking water facilities.

In 9 places, including most of the larger ones, workers were healthy looking. In 4 the majority were only fairly so, and in 2 quite a number were seen who did not appear well. Their chief *complaints* were the fumes, absence of hoods and poor room ventilation. One case of chronic plumbism was seen, and 1 case of antimony poisoning, causing dermatitis as well as bronchitis. *Comments.* — The better places have melting pots for scrap metals in a room separated from other workers. Also, over the type-metal pot, heating apparatus and gas flame is a hood and stack passing to the exterior. In some places the stack was found to extend only a few feet above the machine, whence its fumes were given off to the air of the room.

PRINTING. — PRESS ROOM WORK.

This process is here reported upon as investigated in 13 plants, all printing and publishing establishments, employing a total of 392, of whom 360 were males, and 32 were females. Four plants were unionized. The general attitude towards employes seemed good in 12, and at least fair in the 1 remaining place. The workers were uniformly of an intelligent type. Retention seemed good in all places. Health appliances, consisting of hoods and flues for drawing off escaping gas fumes in drying freshly printed work were present and efficient in 2 places. A sick benefit association existed in 1 place. The majority of the workers were skilled in 3 places, and largely unskilled in 1 only. There were 35 employes over 40 years of age, 327 between 20 and 40, and 38 under 20. The press-room was hygienically constructed in 7 places, fairly so in 3, and not so in 3. Other processes were usually absent in the press-room.

A slight amount of *dust* was in the air in the majority of places. *Cleanliness* was excellent in 3 and fair in the remaining 10. *Dampness*, because of poor location, was a fair hazard in 4 places. *Light* was good in 8 places, fair in 3, and poor in 2 places. General room *ventilation* was excellent in 2 places, fair to good in 7, and poor in the remaining 4, due to lack of means to keep the air in motion, ingress of city smoke, ink odors, and gas fumes from driers. *Heat* was negligible in 5, fair in 7, and bad in 1 place, due to unflued gas-burners. *Fatigue* was not much of a feature, although constant standing, awkward postures, and a good deal of noise were common. The workday was 8 hours in 9 places, and from 8½ to 10 hours in the remaining 4. Some overtime was the feature of several places, while night work and night shifts, in the case of large dailies, were, of course, the rule. The noon recess was 1 hour in 1 place, ¾ hour in 5, and ½ hour in 7. The risk of contracting *communicable diseases* was negligible in 5, fair in 5, and bad in 3 places, due, chiefly, to promiscuous spitting, absence of cuspidors, inadequate wash-places and closets, and common drinking cups. Industrial *poisoning* was negligible in most places; the chief danger was in cleaning off rolls with compounds rich in anilin oil, to which our attention has been called several times. The workmen concerned were found unconscious with the features very dark colored, and only revived after hours of resuscitating efforts. Free-flame gas burners and benzine fumes were other air-contaminators. Industrial *stimulant-*

ism was more or less incited in half of the places, chiefly because of the depressing influences of poor room ventilation.

In 10 places all workers looked healthy, while in the remaining 3, several *appeared* to be sickly. No *complaints* were made by workmen, with the exception of the odors of gas and of inks occasionally. *Comments.* — Outside of the general features above mentioned, the escape of fumes and gases should be prevented by good suction flues at certain points, and precautions used in regard to substances employed in the cleaning of rolls.

PRINTING. — BINDING ROOM PROCESSES.

These were investigated in 6 establishments. The total persons so engaged was 214, of whom 129 were males and 85 were females. There were no labor unions. The workers were of an intelligent class in all places and retention seemed good everywhere. There were no unions in the places investigated. There were no sick benefit associations. The work did not require much skill. There were a total of 20 persons over 40 years of age, 150 between 20 and 40, and 33 below 20. Work rooms were hygienically arranged in 5 places, and not so in 1. Other processes of minor health significance were also carried on in most of the binding rooms visited.

Dust was present enough to constitute a fair hazard in 4 places. One place was poorly lighted. Room *ventilation* was excellent in 1 place, fair in 3, and bad in 2. *Heat* was considerable in 1 place, and a fair hazard in 2 others. Inefficient heating with alternating heat and cold exposures were present in 1 place. *Fatigue* was only a nominal hazard, although heat, work, monotony and constant standing were features in some places. However, the hours were good. The work day was 8 hours in 3 places, 8½ in 1, and 9 in 2. The noon recess was ½ hour in 3 places, ¾ hour in 2 places, and 1 hour in 1. The risk of contracting *communicable diseases* was excellently provided against in 3 places, but fair to bad in the remaining 3, due, principally, to promiscuous spitting, absence of cuspidors, inadequate washing facilities and closets, the use of common towels and cups, the same toilets for both sexes, and the lack of medical supervision. The use of *poisons* was no factor in the process, although occasionally shellacs dissolved in wood alcohol were reported. The inducement to industrial *alcoholism* and stimulants constituted only a fair hazard in some of the places, due to the combination of some of the depressing influences above cited.

The general *appearances* of workers in this process were good in all places, although in 1 place a worker was said to be at home on account of consumption. *Comments.* — This part of the printing business is practically a general factory process with no hazard peculiar to it. The location upon upper floors where city smoke invaded the quarters was a complaint in 3 places, making it necessary to keep windows closed. Fans or air agitators in the rooms would help considerably to invigorate the workers.

PRINTING. — ART WORK, HALF TONES, ZINC ETCHING, ETC.

The processes included here are designing, artist's work, aerographing, photo-engraving, etching, vignetting, transfer work (decalcomania), graining, stippling and sketching. These processes were investigated in 6 plants making such work their sole specialties, and employing a total of 157 workers, of

whom 2 were females. Also one electrotype plant had 37 workers (all males) engaged in the process here named. Similar lines of work are also reported under special industries (see Pottery, etc.). The workers were of necessity of good intelligence, yet the attitude toward them in 2 places seemed rather bad. There were no health instructions, placards, or special appliances, although precautions were ordinarily good. There were 32 over 40 years of age, 123 between 20 and 40, and 2 under 20. The construction of work rooms was excellent in 5 places, and bad in 1. Other processes, such as litho-transferring and stone work, were also carried on in the same quarters in 3 places. *Dust, dirt*, and *dampness,* were fair hazards in 1 place. In 2 places the room *ventilation* was bad and the air pungent with turpentine, electroplating, and various chemical fumes. *Fatigue* was no factor, except that eyestrain might ensue from the arc-lamp reflections in long exposures in the photography branch. *Inactivity* was a hazard, however, to all the sedentary workers (artists, designers, wood and steel engravers). The liability to *communicable diseases* was usually slight, but in 1 place there was promiscuous spitting, the absence of cuspidors, inadequate washing facilities and closets, which, with the use of common towels and dry sweeping, constituted considerable hazard.

Many *poisons* were used in the various sub-processes named. The *artists* were liable to lead, arsenic and chrome poisoning from the habit of tipping the brushes in the lips and especially from the aerographing work. Often their faces were within 8 to 14 inches of their work and in the field of the spray. In some instances one could distinguish the artists from the designers by the pallor on the faces of the former (lead poisoning (?)). The *photographers* handled potassium cyanid in concentrated solutions (both in and out of the dark rooms), also corrosive sublimate, iodine, silver nitrate, copper sulphate, and metol, from all of which they complained of skin eruptions, ulcers, pigmentations and dermatitis. Precautions were usually well observed. Lots of running water was usually depended upon to prevent skin effects. The *photo-engravers* came in contact with benzol in dissolving rubber films, alcohol and ether in collodion films, strong acetic acid in removing films, ammonium dichromate and gas fumes in sensitizing the copper plates, and ferric chloride in etching; also nitric acid fumes from the open rocking trays, as well as fusion products in zinc etching. There were no risks in *routing* and *blocking,* except in the case of electrotypes which are mounted on lead backs. *Vignetters* used ferric chloride as the etcher which, in bulk form, contained enough free hydrochloric acid to produce some skin irritation if used carelessly. *Proving* is the same as Printing Press Work (*q. v.*) Skin eruptions, nose and throat irritations and bronchitis were the chief complaints.

Comments.— Placards concerning the poisons used, labels on all poisonous materials, and ventilation in small rooms, would do away with all poisoning dangers, providing personal care (also in aerographing) were well observed. The use of rubber gloves is said to be impractical.

Cases of *appreciated poisoning* in the industry are rare as is shown in the Report of the 15th Annual Convention of the International Photo-engravers Union, 1914. Out of 42 locals (about half of the total in the union and probably representing the great majority of the workers) which responded to a request on the part of the officers for information upon "Members incapacitated for work by accidents from machinery, chemicals, gradual poison-

ing, loss of weight, or other disabilities incurred in the pursuit of photo-engraving", 34 locals, reported no cases, while 8 reported as follows:

Bichromate poisoning	5 cases
Cyanide poisoning	1 case
Accidents (routers and blockers)	9 cases
Blood poisoning (laid to zinc in a cut)	1 case
Gradual loss of eyesight (Finishing)	1 case
Nervous Breakdown	1 case
Total	18 cases

On the other hand, that some malignant factor (chronic poisoning ?) is at work among photo-engravers is shown by the enormous death rate from tuberculosis and degenerative diseases: of 23 deaths in the fiscal year ending June 30. 1914, 9 were from tuberculosis, 7 from degenerative diseases, 1 from accidental poisoning, 1 from erysipelas, 1 from intestinal obstruction, and 4 from accidents and injuries. — Furthermore (p. 45, of above mentioned Report), "A review of our records since 1903 discloses the fact that there have been 217 deaths. Out of these 217 deaths, 88 were due to tuberculosis — *very nearly 41 per cent.*" (Italics are ours.)

LAUNDRY, — LISTING, SORTING AND MARKING.

This process was investigated in 7 places employing a total of 142 employes, 14 of whom were males and 128 females. Of the total number, 134 were between 20 and 40 years of age. The health-hazards were exposure to *humidity* and *dampness* (due to other processes) in 4 places; dark, close and *unventilated* quarters in 3 places; standing and monotonous character of the work, and nauseating odors from soiled clothing. The liability to the contraction of *communicable* diseases from the handling of soiled clothing and linen is of course present, but is a much disputed point in actual fact. In this connection it will first be necessary to have sick records kept of at least several hundred of such employes over at least a year's time before conclusions can be reached. On the other hand, eating in the work room, meagre washing facilities, the use of common towels and common drinking cups, were features in 3 of the 7 places. The general character of the work also would appear to make it inadvisable to employ both males and females at it together. The appearance of the workers was generally good in 2 places, and fair only in the remaining 5 places. The workers made no complaints.

LAUNDRY, — WASHING.

This process was investigated in 19 laundries, all of the character using machinery to a large extent. It was also investigated in such places as dry cleaning establishments, and in some large firms who performed their own laundry work — the general features being similar to what is here described. It is recognized that some work must necessarily be done by hand. The total number of employes was 241, of whom 118 were males and 123 were females. For the work undertaken the methods were modern in 12 places, fairly so in 3, and not so in the remaining 4. No union organizations existed. The general attitude towards employes was good in 11 places, fair in 6, and poor in 2. Employes were of an intelligent type in 13 places, fairly so in 4 more, and ignorant foreigners in

the remaining 2. Retention seemed good in 13 places, fairly so in 3, and not so in the remaining 3. Health appliances, consisting of exhaust apparatus over operations, and, when needed, special room ventilation apparatus, were fair to good in 11 places, and absent in the remaining 8. In 4 places health placards, etc., were found present. In no places were there sick benefit organizations. The construction of work quarters was hygienically good in 10 places, fair in 2, and not so in the remaining 7. Other processes than washing were present in 8 places. The work was unskilled. There were found to be 2 employes over 40 years of age, 214 between 20 and 40, and 25 under 20.

Uncleanly quarters were noted in 5 places, and especially so in 2. General room *humidity*, wet floors, and steam, were negligible factors in 4 places, fairly so in 3, and bad in the 12 remaining. In some of these, attempts made to better the conditions were quite inefficient. *Light* was good in 14 and bad in 5 places. The workroom *ventilation* was good in 5 places, and not so in the remaining 14. Several depended solely upon windows for ventilation. *Heat* was no hazard in 9 places, fairly so in 9 others, and bad in the remaining 1. In some places it ranged from 80 to 90 degrees, which, combined with humidity, rendered it especially deleterious. Washing facilities, such as shower baths, were absent in all but 2 places, although other types were good in 7 places, fair in 7, and poor in the remaining. *Fatigue* was some factor and due principally to monotony, hurrying, constant standing, faulty postures and constant rapid movements. In some places were excellent rest rooms and lunch rooms where coffee was furnished at the noon hour. The workday was 8½ hours in 1 place, and from 9 to 10 in the balance. The noon recess was 1 hour in 5 places and ½ hour in the remaining 14. The liability to the contraction of *communicable diseases* was negligible in 7 places, fairly so in 8 others, and considerable in 4, due to such features as promiscuous spitting, absence of cuspidors, the use of common towels and drinking cups, inadequate wash places, poor toilets, work clothes hanging in the same room, and the absence of medical supervision to keep out frail and diseased workers. *Poisoning,* due to the effects of bleaching powder and of sodium carbonate, appeared some risk in a very few places, although no cases were found. Bleaching by electricity (a harmless process) was in vogue in some places. On the other hand nauseating *odors,* due both to piles of dirty clothes and washing odors, were fairly frequent. Escaping unburned gas fumes, usually from other processes, were present in some places. The inducement to *stimulantism* was a fair hazard in the majority of places, due to the depressing influences of various combinations of the hazards above mentioned.

The general *appearance* of workers was good in 13 places, and fair to bad in the remaining 6, where many were in need of physical examinations to determine their health status. *Complaints* on the part of the workers were surprisingly few and pertained to heat principally, and fatigue secondarily. *Comments.*—Air conditioning systems to supply cool air in summer and warm air in winter, with means of removing humidity, as by suction fans or hoods, are urgently needed in many places. In addition, good floor drains, impervious aprons or clothing, proper shoes or boots, variations at process so that females in particular need not stand constantly, adequate wash facilities (even to shower baths), a proper place to hang street clothing outside of the wash room, and the separation of the washing process from other processes, are chief correc-

tive features. Again, a careful record should be kept of all sickness and its character.

LAUNDRY. — MANGLING.

This process consists in taking flat work, as a rule, which has just come from the washing machines and extractors and passing it through cylinders which are heated by steam pipes or electricity. While the central cylinder exposes an iron surface the others are usually covered with felt. The workers stand on raised platforms at the large mangles, while they may sit down at the smaller ones. Feeders introduce the goods into the rolls while folders on the opposite side of the machine remove them.

The process was investigated in 15 plants employing a total of 362 wage-earners of whom 22 were males and 340 were females. The work, although unskilled, engaged a fairly intelligent type of workers in two-thirds of the places. There were no union organizations. The retention of the workers was good in 12 places and at least fair in the remaining. The attitude towards workers seemed excellent in 9 places, good in 4 more, and not so in the remaining 2. Some instructions along health lines were found in 2 places. There were no sick benefit organizations. Health appliances (see below) were good in 9 places, fair in 2, and absent or inefficient in the remaining 4. The general construction of work quarters was good in 6 places, fair in 6 more, and poor in the remaining 3. Other processes, such as washing, ironing, marking and sorting, were present in the same room in 9 places. There were 16 persons over 40 years of age, and about 25 under 20 years of age.

Steam, humidity and *dampness* were negligible in 6 places, fairly so in 4 more, and bad in the remaining 5. In some places this was as much due to the washing processes present as escape of steam from the mangles themselves. In 3 places quarters were unduly *dark.* General room *ventilation* was good in 5 places, fair in 5 more, and poor in the remaining 5, due to the lack of air exchange and the contaminations from the processes present. The room *temperature* was good in 3 places, fairly hot in 8 more, and unduly so in the remaining 4. In about the same proportion washup facilities were meagre, while here and there toilets were located at a distance and were only reached through cold passage ways. *Fatigue* was a bad feature in 1 place, fairly so in 8 more, and negligible in the remaining 6. The chief features were constant standing and monotonous work, particularly in the case of young girls. Piece-work was noted in but 1 place. The awkward postures assumed by many, and the self-same rapid movements, were also features. The workday was 8 hours in 1 place, and from 9 to 9½ in 7 places, and 10 hours in the remaining 7. In a few places it was shortened on certain days of the week. Saturday afternoon off was the rule at all places. The noon recess was 1 hour at 1 place, and ½ hour at the remaining 14. The risk of contracting *communicable diseases* was negligible in 5 places, but a fair hazard in the remaining 10, due to such features as common cups and towels, inadequate wash places, poor toilets, absence of lockers, crowding of workers side by side, and lack of medical supervision. In only a few places were men and women working side by side. Medical supervision is quite important since the large machines require a number of persons to work close together. *Poisoning* is no feature of the process, but escaped and incompletely oxidized gas fumes were noticeable in

2 places. The industrial inducement to *stimulantism* was in direct proportion to the extent of heat, moisture and fatigue factors.

The *appearance* of the workers was generally good in 9 places, and no more than fair in the remaining 6. Here and there were some who were plainly affected by the heat. *Comments.*—For the escape of steam there should be provided exhaust hoods as closely suspended over mangles as possible, room exhaust fans, air-agitators and perhaps air-conditioning systems such as a number of places have already installed. In 1 place cool air blasts were provided. Changing about between feeders and folders would do much to vary the monotony of the work, as the folders can usually sit down.

LAUNDRY. — IRONING.

This process was either machine ironing or hand ironing. In the former, goods are passed through cylinders resembling mangles and arranged to suit the classes of goods to be ironed. They are usually operated by the use of a foot lever which is several inches above the floor. The machines operate very fast, as a rule, and have different names, such as body ironers, cuff ironers, etc. In the processes here described, dampening, drying and starching, which are closely associated, are included with ironing.

This was investigated in 21 establishments employing at this process a total of 774 wage-earners, of whom 34 were males and 740 were females. The use of modern methods prevailed in 10 places, fairly so in 6, and not so in the remaining 5. Health appliances, consisting of exhaust fans and air-agitators for room ventilation (and in a few instances of compressed air to operate the rolls, instead of a foot lever), were good in 9 places and absent in the remaining 12. Definite instructions along health lines were being given in 5 places. There were no union organizations. The general type of workers was good in 13 places, fair in 6 more, and largely ignorant foreigners in the remaining. The attitude toward employes appeared excellent in 14 places, fair in 6, and not so in the remaining 1. Retention seemed good in 16 places, fair in 3, and not so in the remaining 2. There were no sick benefit organizations. Work rooms were hygienically constructed in 9 places, fairly so in 3 more, and not so in the remaining 9. Other processes than those mentioned were present in 4 places. There were 14 persons over 40 years of age, and about 80 under 20. The work is unskilled, although a little experience develops a high degree of dexterity.

General *cleanliness* was good in 18 of the places, and at least fair in 2 of the remaining. *Humidity* was a bad hazard in 4 places, fairly so in 6 more, and negligible in the remaining 11, the cause being escaped steam, and, in some places, wet floors. Seventeen places were well *lighted,* 1 fairly so, and 3 not so. General room *ventilation* was excellent in 5 places, and fair to good in 14 more, but bad in the remaining 2. This was due to motionless air, contamination by unburned gas fumes from heating appliances and somewhat by odors arising from solutions and goods. *Heat* was a bad feature in 2 places, and fairly so in 10 more. *Fatigue* was a factor in practically all places, due to the nature of the work which seems to require (?) constant standing for the majority of the workers, and in a rather unnatural posture, with monotonous movements rapidly performed. The constant use of the foot lever is the most fatiguing feature. In 9 places there was evidence of hurrying piecework. There was

also considerable eye strain, due to the constant looking downward upon white and other glazed starched goods. This is more pronounced among hand ironers. The workday was 8 hours in 1 place, 8½ to 9 hours in 4 places, and 9 to 10 hours in the remaining 16, with some variations on certain days. The noon recess was 1 hour in 2 places, and ½ hour in the remaining 19. Overtime was rarely resorted to. The liability to the contraction of *communicable diseases* was negligible in 9 places, a fair hazard in 9 more, and bad in 3, due principally to inadequate wash facilities and closets, the use of common drinking cups and towels, and to the lack of medical supervision, especially for the large number of young females employed. Liability to *poisoning* is no feature of the process itself, provided gas connections are good; otherwise, there is considerable danger of chronic gassing. This is the same for hand ironers, as elsewhere described. The industrial inducement to *stimulantism* was found to be a fair hazard in at least 13 places, due to the depressing influences above described.

The general *appearance* of workers was good in 12 places, and only fair in the remaining 9. *Complaints* by workers themselves were not numerous, although in many instances they appeared either too busy or too timid to answer questions. Their statements consisted chiefly of fatigue symptoms, heat effects, especially in warm weather, and the frequency of headaches and indispositions. *Comments.*—Work variation appears to be the most feasible means of meeting the question of fatigue in this process. This should be insisted upon irrespective of the wishes of employes. Standing upon cement or other hard floors should be prevented by the use of mats, low platforms, etc. Instructions should be given in how to stand, and in the avoidance of awkward postures. The leaning upon hand irons with the breast or stomach is apt to be productive of digestive troubles, chief among which ulcer of the stomach and gall bladder troubles are to be feared. Frail girls should not be permitted to manipulate heavy hand irons nor foot treadle machines. This question of fraility and qualifications for such work cannot be judged by the mere appearance of a worker. All of these employes should be under proper medical supervision. The frequency of lower limb complaints, under par conditions, female disturbances, and neurasthenia among laundresses, is well known. Much headache can be prevented by arranging the workers properly in respect to light, and in the use of eye shades; darkened glasses for workers on white goods would prove very restful. Other features are suggested in health hazards above mentioned.

DRY CLEANING.

Dry cleaning involves various chemical and mechanical processes for the cleaning and removing of spots and stains upon clothing and various textiles. While naphtha (benzine, gasoline), is the chief chemical used, and that which the vast majority of workers are concerned with, a considerable list of other fat, resin, and color solvents are used by a few skilled workers who understand their solvent powers, and are usually well informed as to their poisonous properties. The process in many places is closely associated with dyeing, so that the workers at one process were subjected to the hazards of the other.

Dry cleaning was the chief process concerned in 25 establishments here reported. These were found to employ a total of 142 wage-earners, 73 of whom were males and 69 females. Thoroughly modern methods and equip-

ments were the rule in 20 places, fairly so in 2 other, and not so in the remaining 3, the largest of which employed 5 persons. Health appliances (see below) to protect the workers from breathing the naphtha fumes were of good efficiency in 7 places, fairly so in 2 others, and not so in the remaining 16. Health placards and definite health instructions were present in 2 places. There were no union organizations, nor were there sick benefit societies. The attitude toward workers, retention of workers, and the type of workers were good in 21 places, fairly so in 3 more, and not so in the remaining 1. The work

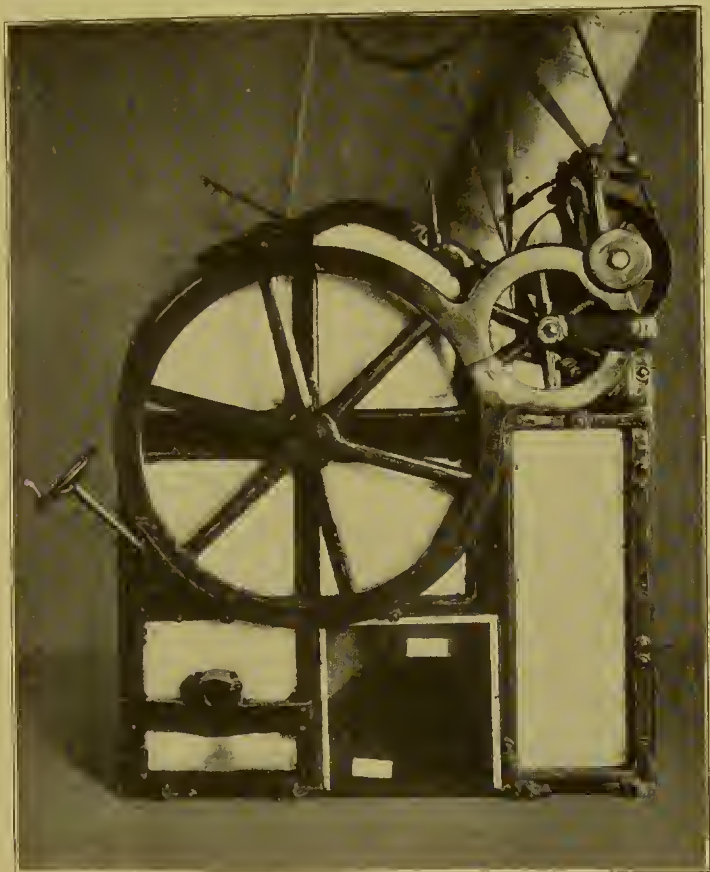

FIG. 51. DRY CLEANING.

A revolving naphtha cleaning tub, completely enclosed and having an excellent exhaust system to remove fumes.

itself required no particular skill. Work quarters were hygienically constructed in 14 places, fairly so in 5 others, and not so in the remaining 6. Other processes (other than dyeing) were found occasionally. In all places great care was taken to avoid fires and explosions in the storage and use of naphtha. In dry cleaning itself there were but 3 wage-earners over the age of 40 while very few, if any, appeared to be under the age of 20.

Quarters were kept *clean* in 22 places and fairly so in the other 3. In 7 places dampness and *humidity* were fair hazards, while in the balance they were negligible. Quarters were well *lighted* in 20 places, fairly so in 2 others,

and not so in the remaining 3. The *air* of the workrooms was satisfactory in 4 places, fairly so in 15 others and not so in the remaining 6, due to the contamination of escaping naphtha fumes. In 2 places quarters were kept unduly *warm*. Workers also had a tendency to dress very lightly, and to expose themselves outdoors, or to *drafts,* rather frequently while so clothed. In some places the isolated dry cleaning building was entirely devoid of heating methods. *Fatigue* was a negligible factor in 22 places, but in at least 3 establishments there was constant standing even where females were employed. The work-

Fig. 52. Dry Cleaning.

Showing method of hot drying of articles so that workers do not need to enter the drying room, which is filled with hot naphtha fumes.

day was 8 hours in 1 place, from 8½ to 9 hours in 15, and from 9 to 10 in the remaining 9. The noon recess was 1 hour in 13 places, and ½ hour in the remaining 12. Outside of the disputed risk of handling used garments, there was no particular liability toward contracting *communicable diseases* in 21 of the places, while in 4 there was promiscuous spitting about the floors, and the absence of cuspidors. As a rule there were very few employes doing this work in any one place, although in the cleaning of gloves, and similar small pieces, there were as high as 25 females employed. The absence of lockers

and the use of common towels and common drinking cups were frequent observations. In 4 places the escape of naphtha fumes was sufficient to cause chronic *poisoning*. Fortunately these were all small places, employing 1 or 2 men at the process. In 19 other places the odor of naphtha was definitely present, but in rather too small amount to affect the health of workers, providing undue individual susceptibility were guarded against. Many workers appeared to expose their hands more than necessary to naphtha. The use of other dangerous substances, such as ether, chloroform, acetone, wood alcohol, benzol, turpentine and carbon bisulphide was always limited in amount, and looked after by a skilled worker. Industrial inducement to *stimulantism* had for its chief factor the depressing influence of the inhalation of the fumes.

The general *appearance* of the workers was good in 19 places, fair in 4 others (including 1 establishment employing 14 help, of whom 8 were females), and poor in the 2 remaining (both small places). In 5 places workers *complained* of poor ventilation and the insufficiency of methods used to remove the fumes. Their symptoms were the usual ones of acute and repeated benzine poisoning. Investigators saw 2 cases of mild, acute benzine poisoning, and 2 whose symptoms were evidently due to chronic benzine poisoning. In several instances workers were remarkably pale as well. *Comments.* — The complete enclosure of naphtha tubs, or the complete confinement of the fumes within the tub, except during brief intervals of opening and closing, were the methods usually taken. In addition, for table work and open vats, room-exhaust fans and hoods locally applied, with down-draft fans, should be used. Floors should be impervious and easily drained.

The subsequent DRYING of the cleaned articles should be done in cabinets or cupboards which do not have to be entered. This can be effected quite easily by the use of sliding racks, upon which the articles are hung, and so arranged that when the rack is within the cupboard, or is in the room outside, the cupboard is entirely closed. There should be, also, a slight suction in this cupboard to prevent leakage into the outside room. It was further claimed that agitating the air in this cupboard greatly facilitated the drying.

CARPET CLEANING. — Carpet cleaning is sometimes also done by dry cleaning establishments. This was investigated in 3 places employing a total of 24 wage-earners, all males. In all places *dust* from the carpets was a bad hazard. In 1 place the people in the neighborhood complained very much on this account. In all places there seemed to be great liability to the contraction of *communicable diseases,* due not only to the dust coming from the carpets but to carelessness in spitting upon the floors and in the inadequacy of wash-places and proper toilets. *Cleaning* of quarters was usually done by dry methods. Windows were depended upon for *ventilation.* Quarters were very dirty in 1 place. After removing the dust from the carpets, they were next scrubbed either by hand or in a tumbling machine, without any material hazard to health. Again, some rugs, and, even, carpets were cleaned in naphtha baths, without practically any protection from the *fumes.* Fortunately, this latter process was not a continuous one.

DYEING.

The process of dyeing clothes was investigated in 13 places, and of hats in 1 place. The dyeing of textiles (not an extensive industry in Ohio) was

investigated in several places as well. The total workers so engaged numbered 422, all males. The type of workers and their retention was good in all but 1 place. The attitude toward workers was good in 10 places, fair in 3, and not so in the remaining 1. There were no unions; also no sick benefit associations. The amount of skill necessary, so far as the workers were concerned, appeared to be very limited, this probably being due, in a large extent, to the use of anilin dyes in modern methods. In 5 places, health appliances consisting of hoods over certain vats and tubs, and room-exhaust fans were good; in the balance they were absent. The construction of the work room was good in 6 places, fair in 3, and poor in the remaining 5. Usually the dyeing room was by itself, but in 2 places washing, steaming and pressing were being done — in 1 place engaging 10 females. There were 6 persons over 40 years of age, and none, aparently, under 20.

Dust is not a feature of the process, although the careless handling of some of the dye ingredients might easily cause poisoning in such form. Quarters were *cleanly* in 10 places, fairly so in 2, and not so in the remaining 2. There was unnecessary exposure to *dampness*, steam and wet floors in 1 place, and a fair exposure in 11 more. Quarters were poorly *lighted* in 4 places, but good in the remaining 10. General room *ventilation* was good in 3 places, fair in 8, and bad in the remaining 3, the hazard of quiet, still air being accentuated in several places by the presence of gasoline fumes and steam. While *heat* is a necessary feature of dyeing, it constituted no health-hazard in 13 places, the remaining 1 being unduly hot. On the other hand, 2 places were very poorly heated for winter work (both small). The process was not *fatiguing*, although there was considerable standing-still. The workday was found to be from 9 to 10 hours in all places; the noon recess 1 hour in 8 places, and ½ hour in 6 places. The liability to the contraction of *communicable diseases* was negligible in 1 place, a fair hazard in 8 others, and considerable in 5 others, due, principally, to promiscuous spitting, absence of cuspidors, inadequate wash places, poor toilets and the use of common cups and towels. (The question of handling used garments is discussed under Dry Cleaning and in Laundry Processes.) The liability to *poisoning* was some hazard in all places, and particularly so in 4, the risk being largely one of personal carelessness. Fortunately, the large majority of anilin dyes are non-poisonous. However, the manufacturers' agents for such dyes claim that it is almost impossible to rid most of them from traces of arsenic. The non-labeling of poisonous dye materials is a serious factor, for it was found that practically none of the workers had any information as to which were poisonous and which were non-poisonous. In addition to the dyes, various cleaning substances, especially naphtha, used in auxiliary processes, were encountered in several places. The industrial inducement to *stimulantism* was chiefly influenced by the unhealthy character of the air breathed.

The general *appearance* of the workers was good in 12 places and fair in the remaining 2. The chief *complaints* were the effects of steam and escaped gas fumes, while 1 employe mentioned, particularly, dermatitis. *Comments*.—Good workroom ventilation, and the use of hoods over steam and hot processes are the essential features. Beyond this, workmen should be protected by the requiring of a label upon all poisonous dye ingredients. The almost exclusive use of anilin and vegetable dyes in weak solutions seems to have done away with the danger of poisoning after the solutions are made up.

As STEAM CLEANING is more apt to be done in connection with the dyeing quarters than elsewhere, it is mentioned here. Heat, humidity, alternate exposure to drafts, absence of lockers and dry places for street clothes, and of proper wash-up facilities, were the main hazards, and the mention of them suggests the remedies.

STORAGE BATTERIES.

In the making of storage batteries (electric accumulators) lead plates are cast, usually in machine molds, dressed up, polished, brushed, and lead oxide pastes rubbed into them. The plates or elements are then connected together by soldering and lead-burning processes, using blow pipes as a rule, after which they are placed in lead-lined boxes or glass, or other impervious jars, dilute sulphuric acid added or other electrolyte, and then charged.

The process was investigated in 9 different establishments of which 4 employed but 1 to 3 men; also in connection with 1 automobile factory, 1 automobile repair plant, and 1 railroad shop. One shop employed no workers outside of the owners themselves, the total employes engaged in the remaining 8 plants numbering 529, all males. In no places could methods be regarded as modern, from the point of view of preventing lead poisoning. There were no unions. The attiture towards workers seemed good in 4 places, while interest in their welfare seemed to lag in the remaining. In the 2 largest plants workers were very largely ignorant foreigners, most of whom were unable to speak English. This would include fully 80% of all the workers so engaged. The steadiness of workers in the various processes was considerably interfered with by sickness in the form of lead poisoning. Health protective appliances to remove fumes and dust were quite universally absent or were installed with more or less makeshift attempts, and greatly lacking in efficiency, particularly for the protection of the type of workers so employed. In the 2 large plants medical supervision was being developed at the time of our inspection, while instructions were being published for the workers upon the subject of lead poisoning and its prevention. How far such were intelligible to the workers we were unable to ascertain. Apparently too much was being expected of the physician and too little thought and money devoted to the correction of conditions. In 1 plant employing 6 men at this process the privilege of a sick benefit association was at hand, but the balance of wage-earners enjoyed no such insurance. The work was practically all unskilled. The hygienic construction of work rooms was good in 5 places employing a total of 57 workers, and bad in the remaining 3. Other work than that appertaining to the making of storage batteries was present in the same quarters in 4 small places, thus needlessly exposing such workers to the hazards of the storage battery business.

In practically all work rooms where lead *dusts* or pastes were used, the hazard to health was bad. Methods of generally doubtful efficiency were adopted here and there to prevent it. Employes were supplied with respirators which seemed to be the chief means depended upon to avoid the inhaling of dust. These were indifferently worn. Much of the dust came from the drying down of the pastes upon the work bench and the floor, where moving about stirred it up. There was also great risk from the fine lead dust deposited from fumes in the founding and casting quarters. General *cleanliness* of quarters, an extremely important feature in this line of work, was good in 4 small places,

fair in 1, and bad in the remaining 3, which included the vast majority of the total number of workers. Impervious floors capable of flushing with a hose were a chief absent feature. There was some *dampness* and permanent wetting of floors in some places (as the charging rooms), but this constituted only a nominal hazard and employed few persons. In some places, quarters for a considerable number of the workers were poorly *lighted.* General room *ventilation* was good in 1 small plant, fair in 2 others, and bad in the remaining 5. In the melting and casting processes, *heat* was a fair hazard, although most (not all) of the melting pots and furnaces were fairly well hooded and drafted. Adequate washing facilities for most employes were very meagre, and for hot process-workers no shower baths were provided. *Fatigue* was a considerable factor in 1 place, fairly so in 1 other, and negligible in the remaining 6, the latter employing a total of only a few men, however. The chief factors were hurrying piecework, speeding up, monotony, prolonged standing, and faulty postures. The workday was 9 hours in 2 small places and 10 hours in the remaining 6 places. The noon recess was ½ hour in 6 places, ¾ hour in 1, and 1 hour in the remaining 1, the last 2 employing a total of 11 persons. Occasionally overtime was necessary. Lead *poisoning* is the great hazard in this industry. There is some risk also from the careless handling of acids in pasting, soldering, lead burning, and charging. The chief factors inducing lead poisoning are the use of lead and lead compounds in dust, molten and fumy forms without proper mechanical confinement or removal of the same from the atmosphere which the workers breathed. The next feature is the employing of an ignorant type of laborer in a most poison-hazardous process, —persons whom it is most difficult to instruct in personal hygiene. To accomplish anything here it is necessary to supply workers with special outer garments and keep them clean and in repair, to insist that workers do not eat in the workrooms (by all means proper eating quarters should be provided), that they carefully wash their hands, faces and lips, before eating or putting anything in the mouth, that they do not carry tobacco about in their work clothes so that lead dusts and fumes can contaminate the same, that they keep their finger nails trimmed short, their mustaches trimmed short, and that time be given them at least twice a day to attend to these matters,—preferably just before the noon recess and before quitting time, and that foremen be especially drilled to superintend the carrying out of such measures. A third feature is extreme *cleanliness* of floors, tables, benches, walls and ledges, by wet processes and vacuum cleaners, and the maintenance of the purity of the air by preventing its contamination in any way with lead in any form. Finally, the frequent physical examination of each worker by a competent physician. The industrial inducement to *alcoholism* is greatly favored in this industry by the presence of the poison element—lead—one of the effects of which is to create a craving for stimulants. The frequency of the association between alcoholism and lead poisoning is well known.

In two small places employing a total of 9 men, all were healthy *appearing.* In the remaining establishments, a few to many occupationally diseased workmen were seen. Most of these had prominent signs and symptoms of lead *poisoning*, sometimes of acute form with manifestations just beginning. In addition, numbers of persons reported attacks of colic, and disabilities lasting from a few days to several weeks which were unquestionably due to lead poisoning. Hospitals, dispensaries and physicians, in the vicinity of such works,

gave many statistics of lead poisoning cases. The chief features of these are summarized in Part VI of this report. *Comments.* — Outside of the actual manufacture of the oxides and salts of lead, there is no industry covered in our survey which requires greater precautions against lead poisoning than the manufacture of storage batteries. The means necessary to prevent lead poisoning are summarized above. This is an industry in which conditions are much more to blame for sickness than to workers. These conditions have been successfully coped with elsewhere. It is only fair to say that the seriousness of these things is being more and more appreciated by manufacturers and that many improvements in these same plants have been under way since our inspections were first made, with the result that there has been a noticeable dropping off in the number of reported cases of lead poisoning, when the year 1914 is compared to the year 1913.

The reader is referred to the rules and precautions for the prevention of lead poisoning formulated by the Committee on Storage Batteries, Association of Edison Illuminating Companies, adopted September 15-17, 1914, and approved by the American Museum of Safety (see "Safety," Vol. 2, No. 9, Oct. 1914, p. 219, — 29 West 39th St., New York.) Furthermore, the Ohio State Board of Health has a large placard upon "Instructions to Employes—How to Prevent Lead Poisoning," intended for posting up in workrooms. These instructions were published in the Bulletin of the State Board of Health for June, 1914, p. 845, and are given in Part VII of this report.

DRY BATTERIES.

The manufacture of dry batteries was investigated in 3 establishments, in 3 cities, in which a total of 978 wage-earners were engaged at this process, of whom 761 were males and 117 were females. There were no union organizations in any of the places. The general welfare attitude towards the workers, the type of the workers, and their retention at work seemed good, fair and bad in each of the places respectively. There were no adequate health appliances, no instructions or placards along health lines, nor sick benefit associations. The work was almost entirely unskilled labor.

Dust was a bad hazard in 2 of the places, and to a fair extent in the third, due to the large amount of carbon and "battery dust" used. In one place the men kept faces covered with talcum to prevent "skin from peeling off" in handling hot pitch. One plant was also quite *dark,* and not kept clean. General *ventilation* seemed good in all three places. *Fatigue* was not much of a factor. General sanitary arrangements were usually good, but on account of the dust and the usual absence of cuspidors there was considerable risk of spreading *communicable diseases,* particularly as no medical supervision obtained. Creosote, pitch, benzol, hydrochloric acid, zinc chloride, lead (soldering), mercury (amalgamizing), and the organic bodies found in carbon constituted the *poisons* present; the hazards from all were considerable. In 1 place a large percentage of the workers were pale and anemic looking, in the other 2 places their *appearances* were somewhat better. Our investigators found several cases of skin trouble, with redness, fissuring and itching; also cases of unquestioned consumption; and in some instances of acid burns and zinc chloride burns. *Complaints* were frequent of fumes, dusts, acids, etc. A prominent surgeon in Cleveland claims to have had several cases of epitheliomata (cancer of the

skin) from these workers and thinks they resemble in origin the same class of neoplasms which affect chimney-sweeps. An officer of a company in another city stated that he knew of 3 of their employes who had worked, subject to carbon dust, and who were said to have died of cancer which began in the mouth.

Comments.—It would require an intensive study to determine how best to protect this class of workers. It is well enough to say "local exhausts, hoods, gloves, etc.", but the exposure to the dust is unusual, and very difficult to control. Probably chemists, engineers and sanitarians could suggest some changes in methods which would suffice. It must be remembered that most of these employes probably do not have the cancers develop until years after leaving the employ of the firms.

INCANDESCENT LAMP MANUFACTURING.

As the processes in this industry, with the exception of glass blowing, are quite different from those elsewhere described, it is considered best to take them up separately at this place. The industry was investigated in 7 plants located in 5 cities and employing a total of 1995, of whom 447 were males and 1548 were females. Of this number 82 males and 577 females were engaged in the particular processes discussed here below. The general type of workers was good in all places. Very good effort was made to retain them. There were no union organizations. Considerable attention has been given to health appliances, especially in 5 places. There were no sick benefit organizations reported, though in 1 place a beginning was being made for such. None of the work was of a skilled character. Premises were of fair to good hygienic construction and arrangement in 6 places and not so in 1. Efficiency auxiliaries such as organized welfare promotion, pleasant surroundings, instructions in personal hygiene, and disease prevention, were advantages enjoyed by the workers. Age groups ran very largely to younger persons, there being but 18 over 40 years of age, 455 between 20 and 40, and 174 under 20.

In some departments in 5 places glass *dust* from broken fragments was a moderate hazard, although frequent cleansing by wet methods existed. Respirators were furnished in sand-blast-departments but were little used by the workers. Much of the work was of necessity done in *darkened* rooms and in rooms in which green window-panes obscured the natural light. In 6 places the general room *ventilation* was of no more than fair character, while *heat* was a fair hazard in the same number of places. A considerable amount of *hurrying piecework* was noted in 5 places, much of it of monotonous character, and especially trying upon the eyes, due to flashing of lights, to brightness of lights and to working with fine filaments. The workday was between 8 and 9 hours in 6 places and 10 hours in 1 place, the noon recess being 1 hour in 4 places and ¾ hour in the remaining 3. All places had good rest rooms, employed a factory nurse, required their employes to leave the workrooms at the noon hour, and to eat in the lunch rooms provided for the purpose. At this time the windows of workrooms were widely opened. Considerable study had been given to the subject of eyestrain, and in practically all places seats were provided for stationary work. The liability to the contraction of *communicable diseases* was a fair hazard in parts of places, due to such factors as the use of common towels, crowding (irrespective of room space), flying particles, frequent trivial

injuries and short-intervaled common handling of objects. On the other hand these conditions were found to have been anticipated by first-aid equipments, surgical rooms, good wash places and closets, the keeping of sick records, the supplying of goggles, asbestos finger cots, and in some plants individual lockers and individual towels. Mercury, wood alcohol, phosphorus, escaped gas fumes, and solder, were the chief *poisons* concerned. None were exposed to mercury, which was used in closed containers to produce a vacuum. The red phosphorus was used free of the white or yellow variety in painting, and the risk of lead poisoning from the grade of solder used and its manner of use seemed negligible. On the other hand in many places the air was considerably devitalized by numerous gas flames and contaminated by the escape of fumes from the same. In other places exhaust flues locally applied seemed ample. In certain processes wood alcohol fumes were unduly strong, due to lack of prompt air exchange. In at least 1 place the girls' fingers and hands were moistened through sponging with wood alcohol. The industrial inducement toward the *taking of stimulants* was some factor, due to the effects of eye-strain, fumes and fatigue. Good drinking water faeilities were present in all places.

In all places a few or more workers were seen who were not *healthy looking*. Their chief *complaints* were eye trouble, causing a considerable amount of headache among a goodly number of employes. While this was laid to strain, we are not certain that some of it was not due to wood alcohol. Less often were mentioned foreign bodies in the eyes, trivial cuts and burns, and, here and there, one stated that wood alcohol fumes caused headache, and solder fumes caused sore throats.

A summary of the chief hazards in each department of the process is here given. *Filament Making.* — Wood alcohol, inadequate room ventilation, gas fumes, heat, presence of other processes, hurrying piecework and monotony. *Tubulating, Sealing* and *Painting.* — Gas fumes, heat, wood alcohol, some constant standing, broken glass dust, monotony and hurrying piecework, presence of other processes, sometimes crowding, small cuts and burns, foreign bodies in the eyes. *Filament Mounting, Spidering* and *Winding.* — Eye-strain from fine work, wood alcohol, gas fumes, warm quarters, the presence of other processes, inadequate room ventilation, some crowding, hurrying piecework and monotony, foreign bodies in the eyes, small cuts and burns. *Vacuum Production.* — Eye strain from bright and flashing lights, presence of other processes, heat, some crowding, some escape of gas fumes, hurrying piece-work and monotony. *Photometry* and *Aging.* — Eye-strain, due to bright flashing lights, some constant standing, heat from lamps, presence of other processes, some crowding, hurrying piece-work and monotony, inadequate room ventilation. *Finishing Processes.* — Some eseape of gas fumes and solder fumes, a little eye-strain, wood alcohol, troublesome calluses produced by the use of wire cutters, some hurrying piece-work and monotony, inadequate room ventilation.

Comments. — In all places most of the hazards above enumerated had evidence of being given considerable thought by the managements. However, contrast conditions were frequent; for instance, little attention was paid to heat in some places while cool air blasts were found installed in others, for similar work. Lack of co-operation on the part of some of the employes was unquestionably a troublesome factor at times. For general room ventilation exhaust fans in the walls were installed in many places, in some, rather too high up, we

believed, to be of good service. The addition of air-agitators, preferably the large paddle, slowly revolving type, would help greatly in quarters where many gas burners and methyl alcohol are used. Atmospheric determination instruments, such as the room thermometer and hygrometer are called attention to, especially for warm quarters where youths and females predominate. The examination of employes for physical fitness, already inaugurated, should be greatly extended.

RUBBER. — WASHING.

This process consists in the cleansing and preparing of crude rubber by "cracking" it up in mills, both warm and cold, with running water, after which the rubber is further steeped in large tanks of water.

The process was investigated in 11 establishments. There was a total of 279 wage-earners, all males. The employes were very largely foreigners, many of whom spoke very little English. Outside of their own shifting tendencies they were found to be well retained by their employers. The work is unskilled. Health appliances, such as floor drains, elevated floor treads, the supplying of rubber aprons, boots and gloves were found to be sufficient in 5 places, while 4 others made little attempts along these lines. Work hours were 8 per day in 1 place, 10 hours in 9 places, and 11½ to 12 hours in 1 place. The noon recess was 30 minutes in all except 1 place. Ninety-five per cent of the workers were under 40 years of age. The general construction of the workroom was found to be hygienic in 7 places and fair to bad in 4 others. The process was usually by itself, but in 2 places the mixing and calendering mills were in the same room.

Some soapstone *dust* was used in 5 places, and in 1 place contaminated the air badly. The quarters were kept *clean* and *orderly* in 8 places, while, in 3, waste-products were allowed to accumulate and dry out; furthermore, dry cleaning during work hours was done. The process is necessarily damp and steamy, and because of the absence of ventilators for steam, the *humidity* was excessive in 6 places, and fairly so in 5 more. Wet floors were common. *Light* was good in 7 of the rooms, fair in 3, and poor in 1. Outside of the humidity, the *air* was good in 5, fair in 5, and bad in 1, due to faulty general ventilation of quarters. Rubber *odors* were pronounced in some confined quarters. The *temperature* was satisfactory in 7, and rather uncomfortably warm in 4 places. Washing facilities were poor in 6 places, while but 1 provided a shower bath. Lockers were present in 5 places and change rooms in but 2. Day work was the rule. *Fatigue* was hardly a factor. The contraction of *communicable diseases* was very possible in 2 places, fairly so in 6, and practically nil in 3. The hazards were common cups, inadequate washing places, poor closets, spitting about the floors, absence of cuspidors, and the lack of medical supervision. *Poisoning* was not a hazard in this process of itself. In 3 plants, lead and antimony were being used in dust form in the some room, with considerable liability to poisoning all the workers. *Alcoholism* was favored in 8 places by the lack of good drinking water facilities, the depressing effects of humidity, and absence of change-rooms for removing wet work-clothes and drying them out before the next day's work.

The workers were found to be healthy in *appearance* in 8 places, while in 5 others 1 or more sickly looking men were observed.

RUBBER. — COMPOUNDING.

The mixing together of various ingredients, usually metallic oxides and salts to be mixed with the rubber later, is termed "compounding". According to the various formulas, the dry powders are scooped out of bins and weighed by hand, placed in opentop tin boxes, and carried direct to the mixing mills, or delivered close thereto through pipes, by gravity. Occasionally, the ingredients are first bolted in shakers in a room above, to break up lumps. Unless the shaker is well enclosed, this is exceedingly dusty work. Sometimes anilin oil is poured directly upon the weighed powders from an ordinary cup.

This process was investigated in 16 establishments, employing a total of 151 wage-earners, all males. Methods were considered fairly modern in 6, and as clumsy and antiquated in 10 places. The attitude toward workers appeared to be good in 12 places, fair in 3, and poor in 1 place. The workers were intelligent laborers in 7 places and ignorant foreigners in 9 places. The firms made an apparently serious endeavor to retain workers in 6 places, fairly so in 7 others, while in 3 the attitude toward the workers in this process appeared to be that of "If you don't like the work, quit". Adequate health appliances were not found in any place, but the use of closed hoppers, conveying pipes and receptacles, kept down dust considerably in 5 places. In no places were complete dust exhaust systems found, while in 11 places very little attempt was made to limit dust in the air. This fact was surprising, inasmuch as in all other departments of most of these plants, considerable attention was given to health appliances. In but 1 plant were the workers given instructions by a competent person on the avoidance of lead poisoning. The work day was 10 hours in 14 places, 9½ hours in 1 place, and 8 hours in the remaining 1. The noon recess was ½ hour in 11 places, 1 hour in 4 places, and not ascertained in the remaining 1. There were usually but 1 or 2 men considered skilled in each place. The vast majority of the men were between 20 and 40 years of age. The workrooms were hygienically constructed in 8 places, fairly so in 3, while in 5, poorly so. The process was found in all places to be done in a room or space by itself, although, in many, wide doors and window-ways gave free air access to adjoining processes.

Metallic and poisonous *dusts* contaminated the air badly in 6 places, and fairly so in all the balance. *Dust* and waste-product *accumulations* upon walls, windows, ledges and floors was bad in 4 places, and present to a fair extent in the balance. Dry sweeping during work hours was frequently noted. *Dampness* is not a feature of the process. *Light* was found to be good in 12 places and only fair in 4 others. Room *ventilation* was excellent in 1 place, good in 11 others, and poor in 4 places, the latter due, principally, to confined quarters and the presence of fumes. There were no artificial ventilating systems found. *Temperature* is not a factor in the process. The work is not fatiguing to any extent. The contraction of *communicable diseases* was highly possible in 4 places, fairly so in 8 and practically nil in 4 others, the chief hazards being the use of common cups, improper or absent wash places and closets, spitting upon dust laden floors, the absence of cuspidors, and the lack of physical examination of employes. *Poisoning* by lead and antimony in the shape of dust, and occasionally, anilin in the shape of oil or fumes, was easily possible in 11 places and fairly so in the remaining 5. The chief factors were the dustiness of the work, the ignorance of the workmen, lack of instructions, the

wearing of mustaches and even beards, the eating and chewing at work and in the workrooms, the non-observance of personal care, lack of medical supervision, of proper gloves, the invariable lack of respirators, also clothing supervision, lockers, washing facilities, and, as mentioned above, mechanical protection from the dusts. The industrial inducement to *alcoholism* was decided in 3 places, and fairly so in 8 others, due to the lack of good drinking water facilities, the subjection to the dust and poisons above cited, and the belief among the workers that alcohol prevents metal poisoning!

In no place were all the workers perfectly *healthy appearing*, while in 5, some very sickly looking men were seen. The chief *complaints* of the working men, where they could speak English, were dust and, occasionally, fumes. *Occupational diseases* were encountered as follows in 8 places:

Lead poisoning, positive	22 cases.
Lead poisoning, tentative	5 cases.

Several of these cases had partial paralysis. There were, in addition, 2 cases of acute anilin poisoning reported, but not seen by the investigators, and numbers of hearsay cases of lead poisoning. *Comments.* — Much greater supervision of workmen is necessary in this process, including at least monthly examination of all the workers for signs of lead poisoning, while we feel certain that the ventilating engineer could render the work practically dustless. The hazards named above indicate other precautions.

RUBBER. — MIXING MILLS.

In this process, the previously washed and dried rubber is macerated between steel rolls, while, at intervals, the workman pours upon the rolls a scoopful or cupfull of the ingredients, delivered to him from the compounding room.

Our findings covered this process in 21 establishments, employing a total of 525 wage-earners, all males. The attitude toward the workers was good in 15 places, and at least fair in the balance. The workers were English-speaking in 6 places, but in the remaining the large majority were ignorant foreigners. An endeavor to retain the workers at the process was evident in 20 places and not so in 1. Health appliances, consisting of hoods and ventilating ducts, sometimes with partial curtains, or aprons, placed over the mixing rolls, and with exhaust fans, were found in 3 places; 7 other places had exhaust fans in the upper parts of the room, the value of which, however, was questionable, since, without hoods and vents over the mills, these only tended to suck up the dust into the air. In the balance of the places (11) there were no health appliances of any sort. The noon hour was a 30 minute recess in 5 places, 45 minutes in 2 places, and 5 allowed 1 hour. Overtime was also frequent in 7 places. The work is not a skilled process. Three boys under 20 were observed, and less than half a dozen of the total workers were over 45. The work rooms were constructed hygienically in 10 places, fairly so in 7, and not so in 4. The process was practically by itself in 14 places, and, in the balance, was in the same room with Rubber Washing, Calendering, or other processes.

Dust in the atmosphere was observed in all places. In 10 it was present to only a fair degree, while in 11 places it was bad. The dust consisted of the dry ingredients (Al, Fe, Ca, Zn, Pb, Sb, Soapstone, etc.), which go into rubber, —

lead ranging, according to one analysis of the finished product, as high as 25%. Dirt and waste-product *accumulations* were evident upon the floors, machinery, ledges, etc., in all places, though to only limited extent in ⅝ of them. Dry sweeping and considerable negligence obtained in 7 places. *Dampness* is not a feature of the process. *Light* was good in 16 places, fair in 4, and poor in 1 (located in basement). Room *ventilation* was good in 2, fair in 15, and poor in 4 places, the latter due to bad location, presence of burnt rubber odors, the biting fumes of antimony, and the absence of a room ventilation scheme. *Heat* was not a great hazard, although the warming mills rendered the temperature fairly hot in 8 places, and badly so in 1 confined place. Washing facilities were meagre as a rule. The work is not overly *fatiguing*. The work day was found

Fig. 53. Rubber Manufacture — Mill and Calender Room.
From right to left are two mixing mills, a refiner with a conveyor belt, a warming mill and another mixing mill. The 3-cylinder-high calender is shown at rear.

to be 8 hours in 1 place, 9 to 10 hours in 20 places, while in 5 places night shifts worked for as long as 11 to 12½ hours. Piece-work was the rule, limited by certain restrictions to safe-guard quality of output. Noise was also something of a factor. The contraction of *communicable diseases* was very possible in 9 places, fairly so in 10 others, and practically nil in 1. The hazards were the use of common cups, promiscuous spitting upon the dusty floors, absence of cuspidors, and lack of physical examination: in some places first-aid provisions were lacking. *Poisoning* was about as great a hazard as in the compounding room, due to the same ingredients, which, in dust form, were here scooped out of conveyance boxes and poured upon the rolls. Here and there anilin oil was similarly handled. The risks of poisoning were considered bad in 13

places and fair in the balance, due, principally, to the ignorance of the workers, lack of instructions, wearing of mustaches, eating and chewing while at work and in the work room, lack of personal care, interval medical examinations, adequate washing facilities, and, in most places, lack of process-ventilation appliances to remove dusts and fumes. The odors of anilin and antimony fumes were plainly detectable in several places. Industrial *alcoholism* was greatly favored in 4 places, and fairly so in 15 others, due to improper drinking facilities and the various hazards above cited.

Appearances of the workers were good in 4 places, but in the balance some sickly lookly individuals were observed. Their chief complaints were found to be the breathing of dust and fumes, nausea due to odors, the closeness

Fig. 54. Rubber Mixing Mills.

There is a row of these mills on the left with exhaust hoods to remove poisonous dusts and fumes. Note air-conditioning pipes running full length of room, protected machinery and batch tables within easy reach.

and stuffiness of the workrooms, and the symptoms of poisoning — usually lead Our investigators discovered 30 cases of occupational diseases as follows:

Lead poisoning, positive	22 cases
Lead poisoning, tentative	4 cases
Dermatitis, positive	1 case
Anilin poisoning, positive	3 cases

Comments. — While means of confining or drawing off the dusts and fumes from each milling machine are necessary precautions, personal care, properly taught and supervised, with a monthly examination of the workers, would obviate all of the cases of lead poisoning.

RUBBER. — CALENDERING (INCLUDING WARMING MILLS).

This process follows that of the mixing mills. Compounded rubber is introduced into the rolls of the warming mills and of the calenders which further perfect the material and grade it down into sheets of required thickness. Oftentimes also the calenders are used to press the rubber into cloth fabric, which is called "frictioning".

In 12 places in which this process was investigated there were 793 wage-earners, all males. The welfare attitude of the employers towards the workers was considered to be good in 9 places, fair in 2 others, and not so in one. In 5 places the workers were of an intelligent type, while in 7 they were very

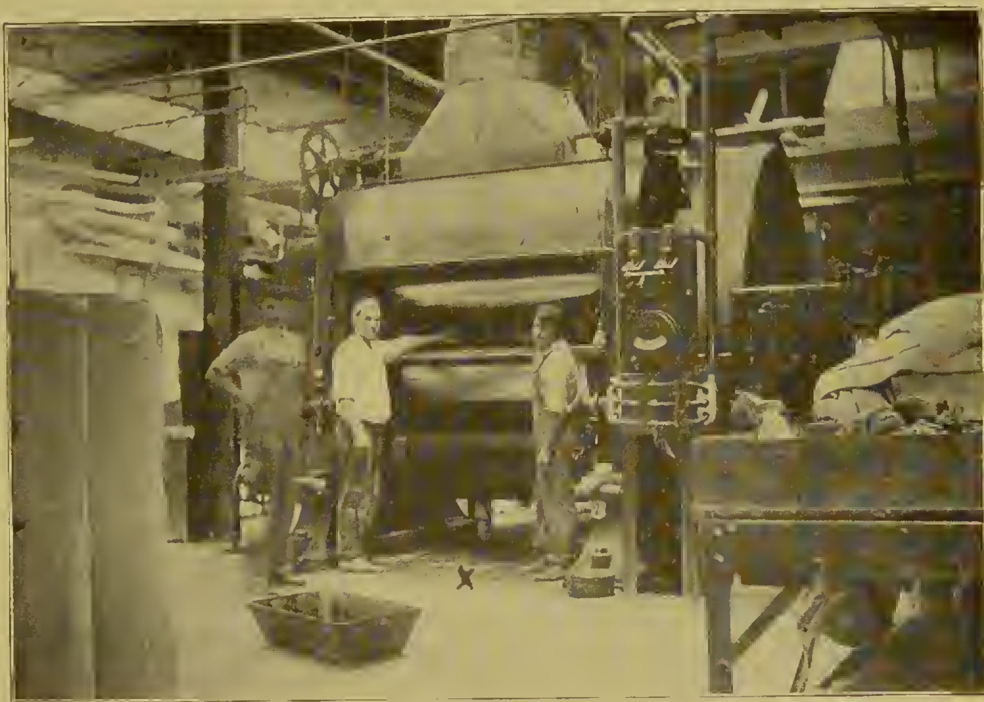

FIG. 55. RUBBER CALENDER.

Note hood above which draws off heated air, odors and fumes. Completely equipped with safety devices, including rubber floor mat "X".

largely ignorant foreigners. Retention of workers was good in 7 places and at least fair in the balance. Health appliances consisting of hoods and stacks with exhaust fans, covering the calenders and mills, were excellent in 2 places. While these were absent from the balance, other health appliances such as room exhaust fans and ventilation schemes were present in 5 places. In 5 others no attempts were made to remove dusts or fumes arising from the process. The day averaged from 10 to 11 hours in 8 plants, with 30 minutes for noon in 10 plants. In the others the day period was 8 to 10 hours, and the noon recess 1 hour. Some overtime was the rule in 3 places. A certain per cent. of men at this process were at least semi-skilled, but about 80 % were unskilled. Rarely were men over 40 years of age seen. There were, however, very few youths

under 20. Working quarters were modern and of hygienic construction in 9 places, fairly so in 1 other, and bad in the remaining 2, due to low ceilings, crowded machinery and the presence of ulterior processes. The process was in the same room as the mixing mills in 5 places, though, in some, well separated.

A fair amount of *soapstone dust* was present in the atmosphere in all places. In most of the places it could be considered almost negligible as a health-hazard. Dust *accumulations* about the floors and ledges were present in all places, although daily cleaning, usually by wet methods, was the rule. *Dampness* was no factor. Nine of the places were well-*lighted,* and 3 only fairly so. Room *ventilation* was good in 3 places, but only fair in 9 others, due to poor location and inadequate or absent ventilating appliances. *Heat* from the rolls was found bad in 2 places, fairly so in 5 others, and a negligible factor in the remaining 5. *Fatigue* factors were moderate and in the shape of limited piece-work, monotonous hum of machinery, with evident speeding up in at least 1 place. The process is also fairly noisy. The danger of contracting *communicable diseases* was considered bad in 2 places, fairly so in 7 others and practically nil in the 3 remaining. The hazards here were the use of common drinking cups, improper washing places and toilets, spitting on the dusty floors, the absence of cuspidors, the lack of physical examinations and of first-aid provisions. *Occupational poisoning* is hardly a hazard in this process, but dermatitis or eczema, due to the dust and to the handling of rubber, may afflict the more susceptible. On the other hand benzine fumes were fairly strong in 2 places. Industrial *alcoholism* was favored in 8 places because of inefficient drinking water facilities, and the influence of the factors above mentioned.

In only 3 places were all workers healthy appearing. Complaints of the workmen were the benzine fumes, a considerable part of which came from open-top cement cans. These fumes, because of the heat, volatilized greatly. In most places benzine was little used in the process. No cases of occupational poisoning were found.

RUBBER. — TIRE-BUILDING.

This process consists in the making of casings for automobile and bicycle tires by the applying of layers of rubber fabric upon wheel-shaped molds; to these are cemented the beads, cover layers, etc. It may be all hand work, the operator sitting or standing before the mold, mounted upright on a pedestal, and carefully stretching the fabric as he revolves the "wheel". In some places more than half of the work was being done by mechanical application of the fabric to the molds, called "machine building".

This process was investigated in 13 places employing 4,135 wage-earners, all males. The workers are among the most skilled in the rubber industry, while the attitude of employers toward them seemed to be excellent in 12 places and at least fair in the other, so that the retention of the men seemed to be good every place. Health appliances consist of means of ridding the atmosphere of benzine fumes and of reducing the laborious character of the work. In 3 plants, only, were attempts made to limit the fumes by so much as using covered containers. Privileges of sick benefits were available to part of the workers in 2 plants. The work day consisted of 8 hours in 2 places and 9 to 10 hour shifts in 8 places and 10 to 13 hours in 3 places, with a noon recess of 1 hour in 2 places and 30 minutes in 10 places. In 3 places, overtime was an

occasional requirement. Fully 95% of the workers were between 20 and 40 years of age; there were some youths under 20, while older men were usually found working in small plants. The work rooms were hygienically constructed in 11 places, but not so in two. Many half-auxiliary processes, such as bead-making, buffing, book-making, and inner tube making, were, as a rule, carried on in the same room. This helped to add to the benzine content of the air.

Dust in the shape of soap-stone was present to a fair extent in all places. The quarters were kept well *cleaned* in 11 of the places, while dust and rubber scraps were allowed to collect in the other two.

Dampness was no factor. *Light* was invariably good. In all places the odor of benzine was detectable and in 5 its concentration was bad. Invariably open windows were depended upon largely for *ventilation*. Fans and air-agitators were uniformly absent as were also room air-exhaust schemes. Two places were equipped with air-conditioning systems for use in winter for supplying tempered air, but these did not remove contaminated air. *Heat* was no factor. On the other hand the effects of *cold* draughts from open windows were a hazard in practically all places. *Fatigue* was more than a fair hazard in most places due to hurrying piecework and, in some places, constant standing in strained positions, faulty postures, jarring processes, pressures against the body, and the lifting and carrying of heavy molds. The contraction of *communicable diseases* was favored in 3 places, fairly so in 5 others, and could be considered negligible in the remaining 5. The chief reasons were the use of common drinking cups, inadequate washing facilities and closets, spitting upon the floors, the absence of cuspidors, and, to some extent, the crowding together of large numbers of workmen without medical supervision. In some places adequate fist-aid arrangements were absent, though bruises and sprains are frequent in the process. There is some likelihood of the direct spreading of venereal disease through the common handling of the same article. The *poisons* to be feared are benzine, antimony and perhaps lead (the last two from handling rubberized fabric). In no place was benzine odor absent, while in 9 of the 13 it was strong enough to cause symptoms. The process necessitates using it with sponges in an open manner, and it is also a solvent for the cements which are applied, usually, by the bare hand, occasionally also with brushes, hence its control is difficult. Continual changing of the air in the room by mechanical means, air-agitators and the keeping of the artificial temperature down in the winter months would help greatly; also the substitution of closed containers with a pressure-valve benzine emitter in place of the open cups now used. Antimony dermatitis was an occasional complaint. Industrial *alcoholism* was favored in most of the plants through inadequate drinking water facilities, particularly, when combined with the depressing effects of benzine fumes and hard work.

In this large body of workmen it was of course possible to find some anemic or sickly *looking* workers in practically all the places. The chief *complaints* were headache, dizziness and stupefaction, due to breathing benzine fumes. Many claim that this bothered them only at first. We have commented upon this toleration to poisons in a previous Part as decidedly unphysiological. Many cases of anemia were seen which were undoubtedly due to the chronic effects of benzine. The workers' disregard of the fumes and the tendency of many of them to scoff at their effects is unfortunate and can only be met by enlightment, particularly upon degenerative diseases.

RUBBER.—STEAM VULCANIZING.

This process is also called "curing", and in many plants the rubber tires were subjected to two steam cures, the first, when the tire was partly built, called "semi-curing", and the second, when the tire was completely built, "final curing". Inasmuch as the curing used to be done in cylinders sunk in pits in the ground (usually in the basement), the "semi-cure" process room retains its name, "the pit". Tire casings are placed in iron molds within the steam cylinders, steam admitted for a proper length of time, then shut off and the cured tires mechanically removed.

The process was investigated in 15 places, engaging 733 wage-earners, all males. The welfare attitude towards workers seemed good in 10 places and at least fair in the balance. The workers were of an intelligent American type in 6 smaller places, while the balance (mostly large places) employed a good grade of foreign labor. The retention of workers seemed good in 6 places, fair in 8 more, and in 1 not so. Health appliances consisting of a hood and vent stack over the openings of the cylinders, air conditioning system for the work room, or air agitators and floor treads or drains to remove water, were good in 3 places, fair in 4 places, and all entirely absent in 8 places. In some of the better places, boots, aprons, and gloves were provided, while others used a procedure which permitted a very little escape of steam, water and excessive heat. The work day was 8 hours in 2 places, 9-10 hours in 13 places; the noon recess was 1 hour in 3 places, and ½ hour in 11 places. Overtime was frequent in 5 places. The work is not skilled beyond the immediate supervision of the foreman. Very few workers were seen over 40 years of age, and practically none under 20. The work quarters were of hygienic construction in 7 places, fairly so in 2 others, and poorly so in the remaining 6, due, principally, to low ceilings and crowded floor or basement, while in 2 places 1 or more additional kinds of work were being carried on.

Dust, due to soapstone, was a bad factor in 3 places, and fairly so in 4 others, while in the remaining 8 there was none, due to a difference in procedure. In 1 place a laudable measure was the wetting down of the soapstone used. Dust and waste-product *accumulations* were bad in 3 places, fairly so in 4 others and absent in the balance. Water, steam and *humidity* were bad in 3 places, fairly so in 8 places, but practically absent in the remaining 4. *Light* was good in 9 places, fair in 5, and poor in 1. Room *ventilation* was good in 5, fair in 4, and poor in 4 places, the latter due largely to location, resulting in closeness, stuffiness, and still air; also to the absence of artificial ventilation schemes. *Heat* was determined as bad in 4 places, fair in 7, and satisfactory in 4. In only 1 place was a shower bath at hand. *Cold* and draughts were bad in 2 places, fairly so in 2 others, and but little factors in the remaining 9. The work is rather *laborious* and on this account big powerful workmen were usually seen. In three places the piecework was promoting exhaustion, while in 1 large plant the men, though working in 8-hour shifts, were hurrying along, many of them, half stripped, and dashing from steam heated to draughty areas in what appeared to be a killing pace. Some places were very noisy. The contraction of *communicable diseases* was highly possible in 5 places and fairly so in 8 others, and practically nil in 2 others. The hazards were common drinking cups, improper washing places and closets, promiscuous spitting, absence of cuspidors, lack of first-aid provisions and of the physical examination of

workers. Venereal diseases have a slight chance for spreading due to the common handling of the same objects. *Poisoning* is not a real factor in the process, except the escape of fuel gas fumes, which seemed bad in 5 places, fair in 5, and no factor in 5 others. Industrial *alcoholism* was much favored in 2 places, and fairly so in 7 others, due, not so much to faulty drinking water facilities, as, to the depressing influences of humidity, dust and fatigue.

In 6 places no sickly looking workers were observed, but in the remaining 9, one or more of such should at least have had a physical examination. In several places *complaints* were made of the heat, or cases of heat-prostration, and of heat colic and cramps. *Comments.*—In certain places the escape of water and steam should be better controlled, and, where locations have been unfortunate, high temperature should be contravened by air blasts, electric fans, etc., as is done in steel mills and elsewhere. Other corrections are suggested in the hazards above mentioned.

RUBBER.—DIPPING.

In this process, molds of gloves, finger cots, etc., are dipped, usually mechanically, into vats containing rubber dissolved in benzine, whereby, when the objects are raised from the vats, a thin coating of rubber adheres to the mold. This process is repeated several times, according to the thickness of objects required. Great precautions are necessary to avoid fire and explosions.

This process was investigated in 11 establishments in which 49 wage-earners, all males, were found so engaged. The workers were either Americans or foreigners of fair intelligence in all places. Retention at the process was fair in 6 places and good in 4. Health appliances, which consist in the provision of hoods with exhaust pipes, curtains, air forced into the rooms under pressure and slatted floors with exhausts beneath were found good in 5 places, fair in 5 more and absent in the remaining 1. The workday was 10 hours in 10 places and 9½ in 1 place; the noon recess was ½ hour in 9 places and 1 hour in 2 places. In addition, the work is of such a nature that an employe is required to be within the room only a few minutes at a time. Probably from 1/3 to ½ of the workday is spent within the dipping room. Overtime was resorted to in 3 places. The work requires no particular skill. All workers were under 40 years of age. The rooms were of hygienic construction in 4 places, fairly so in 3 places and not so in the remaining 4. The quarters were always spacious in proportion to the number of workers employed. In 5 places cement mixing, vapor cures and some other processes were carried on in the same room. These were all small places.

Dust is foreign to the process and was not noted in 9 places, but in 2 others a considerable amount of soapstone dust was observed from other processes. The quarters were *clean* in 7 places, fairly so in 2 others and not so in the remaining 2. *Dampness* was no factor. *Light* was good in 7 places and only fair in the remaining. In all places benzine *odor* was plainly detectable. This amounted to a fair health-hazard in 8 places and a bad risk in 3. Its concentration was in proportion to the absence of health appliances to remove or confine the vapors. Although the process requires warmth, this was not enough to be an unhealthy factor in but 1 place. The rooms were usually close and still in order to keep out dust. *Fatigue* was no factor. The contraction of *communicable diseases* was a fair hazard in 8 places and especially

so in 1, due to the use of common drinking cups, improper wash-places and closets, promiscuous spitting, absence of cuspidors, some common handling of articles and the lack of medical supervision. In the remaining 2 places such factors were nil. Benzine was the only *poisonous* substance used. It constituted a bad hazard in 7 places and fairly so in the remaining 4, especially if an employe were required to remain more than 15 minutes or so in the immediate vicinity of the uncovered dipping vats and the dripping frames above. The process rarely required this. When not in use each separate vat was hooded to prevent waste by evaporation. Industrial *alcoholism* was somewhat favored in 7 places and very much so in 3 others, by the lack of

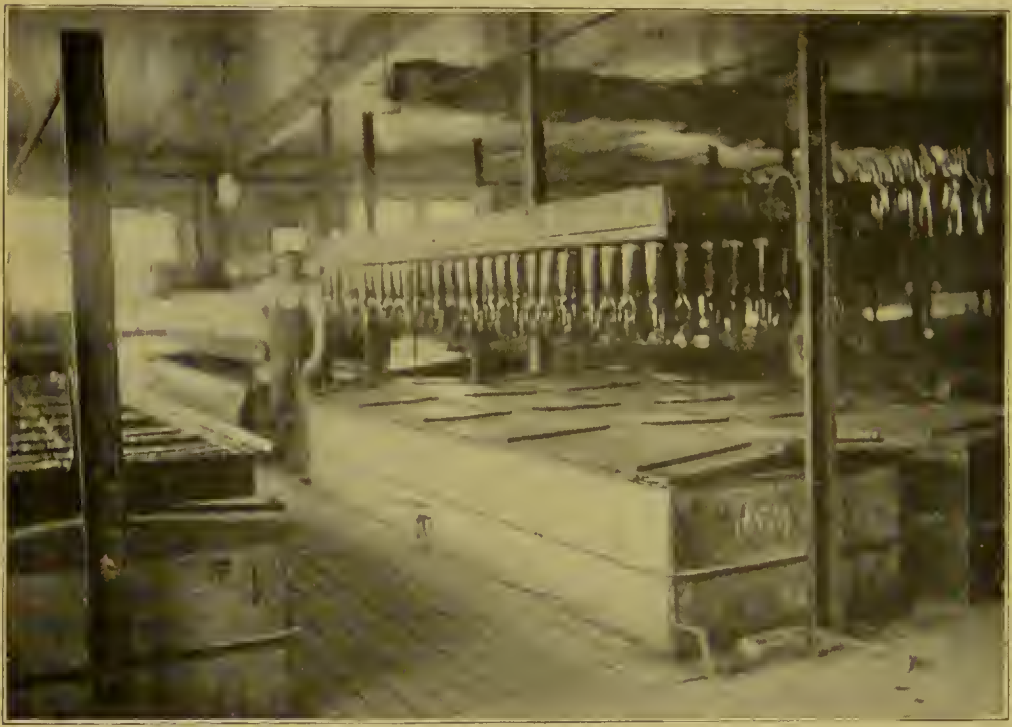

FIG. 56. RUBBER "DIPPING ROOM."

Gloves are made by dipping molds into solutions of rubber dissolved in benzine. The benzine tanks are covered when not in use. The floor is latticed with an exhaust system beneath to draw off the heavy benzine fumes.

adequate drinking water facilities and the depressing influences of the heat and vapors above described.

In practically all places some pale and *unhealthy looking* workers were seen, especially among the older employes. The chief complaints of the workers were dizziness, loss of appetite, tiredness and, occasionally, "benzine jags," due to breathing the fumes. One positive and 2 tentative cases of chronic benzine poisoning were seen. *Comments.* — Health appliances (see above) should be provided in all places where dipping is done on any scale. While in the dipping room, and for a few minutes before, the exhaust ventilation system should be set in motion.

RUBBER.—BUFFING.

In this process rubber tire casings partly built are roughened up by revolving them on a wheel and holding a coarse file against them. Other semi-hard rubber objects are also buffed, usually by pressing them against a revolving emery wheel. The object of roughing up the rubber is to give surface for the cement which is later applied in order to put on further coats or covers.

The process was investigated in 6 establishments employing a total of 168 males and 6 females. The workers were largely foreigners. The work seemed uninviting and retention of workers at the process was not good. But 10 of the entire number of workers, including the 6 females, had any mechanical protection from rubber dust. The workday varied from 10 to 12½ hours; the noon recess being ½ hour in 5 places and 1 hour in 1. The work was unskilled. But 4 workers were observed over 40 years of age, while a considerable number were under 20. The work-place was hygienically constructed in 4 places and only fairly so in 2 others. It was in the same room with tirebuilding in half of the places.

Opportunities for inhaling rubber *dust* were bad in 4 places and fair in the 2 remaining. But 1 place supplied respirators and these were unwillingly used. Many of the workers were as black as coal heavers, due to the dust. In all places except 1, the dust *accumulations* on the floor and vicinity were considerable. Here and there persons were constantly sweeping up and using only a dry method. In some places the rubber was buffed in a semi-moistened condition so that dust was very much reduced. *Dampness* was no factor. *Light* was good in all places. *Temperature* was no factor. The general character of the air in the room, outside of the dust factor, was good in only 1/3 of the places. *Fatigue* was a fair factor in all places, due to the arduous character of the work, piecework, speeding up, monotony, constant standing (except for a very few, including the 6 females), constant strain, the very faulty postures of leaning over with a file pressed across the thigh, the jarring character of the work and the steady application. The contraction of *communicable diseases* was a fair to bad risk in 2/3 of the places, due to the use of common drinking cups, improper wash-places and closets, spitting upon the dusty floors, absence of cuspidors, lack of physical examinations, medical supervision, goggles, gloves and first-aid provisions. *Poisoning* from lead which is in the compounded rubber is a possibility, while benzine fumes were present to a fair extent in most places. The risk of lead poisoning may be considered as in about direct proportion to the dust inhaled and ingested. The workers could be very little blamed for personal carelessness where the dust flew all over them. Proper washing facilities, lockers and eating quarters were present in but 1 place. Industrial *alcoholism* was favored by such factors as fatigue, dust, and perhaps poisoning.

Many of the workers *appeared* very tired. They *complained* bitterly in some instances of rubber dust, "friction" smoke and long hours. In most places the process was acknowledged health-hazardous by the management, while several places were arranging for dust control systems. One questionable act of the workers was the holding of a bare handful of cement dissolved in benzine, and in at least one instance, benzol while applying it to the revolving surface of the tire.

RUBBER.—INNER TUBES FOR TIRES.

Inner tubes are made, generally, of almost pure rubber by lapping long strips of rubber around an iron rod of the proper size, or by butting the edges together on a table top. The rubber is made to adhere to itself by moistening with benzine or benzine cement (rarely benzol). The long tube is next wrapped or bandaged with a wet strip of cloth and then steam cured (hazard somewhat less than steam vulcanizing, described elsewhere), after which the ends are spliced together, as a rule, by a cold cure process. Although a difficult procedure, steam cure for splicing is sometimes used. Only the first process, viz., lapping or edge butting, is considered here.

This was investigated in 8 plants and engaged 389 males and 201 females, usually only the one or the other sex being employed in a given plant. The work requires a little skill and a fairly intelligent type of workers was the rule, the females in particular being largely so. The workers appeared to stay at the process fairly well in but 3 places. Health appliances to remove or confine benzine fumes were absent in all places. The work day was 8 hours in 1 place, and between 9 and 10 hours in all the balance, with a half hour noon recess. Overtime was frequent in 3 places. A vast majority of the workers were youths, and men and women under 40 years of age; not more than 10 were above this age. The work rooms were constructed hygienically in 6 places and fairly so in the 2 others. In 3 places several other processes were in vogue in the same room.

Soapstone *dust* was a fair hazard in 6 of the 8 places. The *cleanliness* of the quarters was good in 5 and fair in the other 3 places. *Dampness* was no factor. *Light* was good in all places. The general character of the atmosphere was good in 1 place, fair in 3, and bad in the remaining 4, due to the closing of windows to keep out dusts and drafts, and to the absence of any artificial ventilating systems, fans, etc. *Heat* is not a factor of the process itself, but in 1 place the quarters were unusually warm, due to their location over the vulcanizing room below. *Fatigue* is a fair hazard, due to piece-work, constant standing, or stools (for females only) without backs, and monotony. The contraction of *communicable diseases* was a bad risk in at least 2 places and fairly so in 4 others, due to the use of common drinking cups, improper wash-places and closets, spitting upon the floors, absence of cuspidors and lack of medical supervision. *Poisoning,* due to benzine and occasionally to benzol, was a bad hazard in 6 places and fairly so in the other 2. Benzine and benzine cement sat about in open cups into which brushes or sponges were dipped. Workers, as a rule, ate in the workrooms. It was claimed in most places that drafts could not be allowed, but in other places the windows were wide open. Industrial *alcoholism* and *coffeeism* were incited in proportion to the extent of poor drinking water facilities, the dust, fumes and fatigue.

In but 2 small places were all the workers of healthy *appearance.* In the larger places a few to a considerable number of pale looking workers were seen. The workers *complained* variously of the effects of the fumes, of the stuffy and close character of the workrooms and occasionally of the dust. Benzine stupor and fainting spells were common, especially among the females and those new at the work. It was said that many girls and sometimes men never came back after the first day or two. In 1 large place each girl averaged 1 day a week off on account of sickness. Sore throat, frequent headaches,

dizziness and tiredness, and other symptoms of acute or chronic benzine poisoning were common complaints. Benzine dermatitis was occasionally encountered. A typical form of complaint was that in which the workers said that physicians appeared unable to better their ills. In 1 place a fainting girl was being rushed to the windows during the time of our inspection. *Comments.* Beyond question, benzol should not be permitted in the way in which it is used (fortunately rarely) in this process. All benzine and benzine cements should be kept in closed containers with some sort of automatic-valve emitter. The room temperature should be kept not over 68°. Some means of changing the air in the workrooms should be provided and everything done to keep down the concentration of benzine fumes. Finally, sickly and tuberculously inclined persons should be kept out of the process through medical supervision.

RUBBER.—SPECIALTY MAKING.

(INCLUDING MECHANICAL GOODS, DRUG SUNDRIES, ACCESSORIES, ETC.)

As "almost anything can be made out of rubber," a vast number of employes are engaged in more or less factory types of processes included under the general heading above. As a rule, their health risks were of a general type plus the breathing of benzine fumes and soapstone dust. The articles made concern all manner of soft and hard rubber, and rubber fabric materials, from tiny rubber bands and washers, finishing-up processes on gloves, toy balloons, etc., the assembling of boots and shoes, rain coats, etc., to the fabricating of fire hose and enormous belts for power transmission purposes. In the small work many females were employed, while in the rougher and larger work, males were engaged.

This class of processes was investigated in 22 establishments in which 2,912 males and 1,668 females were so engaged. A good attitude seemed to exist between employers and employes in 15 of these places. While a large number of more or less ignorant foreigners were employed, still the usual type of fairly intelligent people, particularly females, was the rule. In some processes workers did not appear to remain long because of various objectionable features. Where health appliances were plainly needed, but 2 places were adequately equipped, 6 others fairly so, while 14 had given practically no attention to such features. The work day varied considerably: in 20 places it was from 9 to 10 hours, and in 2 between 10 and 12 hours; the noon recess was ½ hour in 15 places, ¾ hour in 1 place, and 1 hour in 4 places. Practically all of the workers were unskilled labor. A considerable number of youths between 16 and 20 were employed, probably more than the number of workers who exceeded 40 years of age.

Considering these processes grouped by plants, our summaries show the following:

Dust was a negligible hazard in 4 plants, a fair hazard in 12 and a bad hazard (at least for some processes) in the remaining 6. Invariably this was due to soapstone; occasionally, to rubber ingredients. Quarters were kept *cleanly* in 10 places, fairly so in 8 more and not so in the remaining 4. *Dampness* was no factor in 18 places, but constituted a fair hazard in 3 others and was especially bad in 1. It was due to the escape of water and steam. In 17 plants *light* was good, in 3 only fair and in 2 bad. The *air* condition of the work rooms was satisfactory in 1 place, fairly so in 15 others, and bad in

the remaining 6. The reasons for this were poor location, closeness and stuffiness, lack of room ventilating systems, and of local exhausts in many places where they should have been provided. *Heat* was no factor in 17 places, but was a fair to bad hazard in some processes in the balance. *Cold,* due to the opening of windows for ventilation, inadequate heating facilities, sedentary work in drafty places, and going in and out of hot quarters was a factor in some places. *Fatigue* was a considerable factor in 6 places, and

FIG. 57. MAKING RUBBER SPECIALTIES.

This room is well lighted, has an air-conditioner which changes the air continually, thus removing benzine fumes. (Some of the girls are not faced well as respects light).

more or less so in a number of others, due, principally, to the unlimited hurry of piece-work, constant standing, use of stools without backs, faulty postures, jarring processes and, occasionally, loud noises. The liability to the contraction of *communicable diseases* was a bad risk in parts of 5 places, fairly so in 10 others, but well controlled in the remaining 7. The factors were: the crowding together of employes, sometimes in large numbers in rather limited spaces, often quite filled with work benches, shelvings, machinery and stock; the use of common towels and drinking cups; improper wash-places and closets;

spitting upon the floors; absence of cuspidors; frequent trivial injuries without first aid provisions; and the absence of gloves. Occasionally, goggles were needed, and, more especially, medical supervision to keep out persons having communicable diseases. The more or less common handling of articles, and the working together of both sexes were factors, although in no place was anything suggestive of an immoral atmosphere observed. The chief *poison* to which vast numbers of these employes were exposed was benzine. Occasionally, also, benzol, sulphur chloride, carbon bisulphide, ammonia, anilin dyes, wood alcohol, and other less commonly used substances. In but one plant were all employes satisfactorily protected from all forms of poisoning. In 7 others risks were not bad, while in the 14 remaining, acute poisoning, especially from benzine, was very possible. Practically all contributable factors discussed under poisons in Part III. upon principles of industrial hygiene were encountered, sometimes one and sometimes another, and sometimes many in the same establishment. Industrial *alcoholism* was favored in 10 places, 2 especially so, due to inadequate drinking water facilities, added to which the depressing effects of the hazards above cited should be taken into account.

In this vast number of people, it was natural that some *unhealthy* looking persons should be encountered, particularly where large numbers were employed. In 6 plants, however, all appeared well, but in the remaining 16, one or in some cases, many were seen who were unquestionably in the need of a physical examination to determine their health status, and, indeed, their safety towards fellow employes. A summary of the *complaints* encountered by talking to work people constitutes the following: dust and fumes causing nausea, dizziness, fainting, headaches, loss of appetite, loss of weight, tiredness, "benzine jags," eczema, coughs and colds, and "can't work long at this until I am sick and have to lay off for a few days." In some places workers were hard to retain if other work was obtainable. Females were naturally worse affected. Ten cases of chronic benzine (and perhaps benzol) poisoning were seen in 4 plants. *Comments.*—Where so many health-hazards are involved, it is well to aim at a principal one if such a one exists, and endeavor to control it. Usually such a principle results in reducing other bad features. In this class of processes the chief aim should be directed first at a better control of benzine fumes. While these are not a deadly poison and produce no more than a temporary "drunk," and, perhaps, unconsciousness, they are, when inhaled or absorbed, destructive to the blood corpuscles and fat-absorbent in their effects upon the system. Again, it must be said that toleration to such a hazard is beyond the limits of physiology. Inefficient hoods and exhaust systems, absence of such systems, failure to keep the atmosphere in motion and prevent dead air saturated with fumes, failure to provide gloves where needed, escape of fumes to neighboring departments or processes, and the practically universal use of benzine and benzine cements in open cups placed before the workers were the chief features. A feasible closed container for benzine has been mentioned under "Tire Building." After benzine, the next chief hazard was soapstone dust. While much of this in the air was due to carelessness on the part of the employes, the processes are bound to produce it. Much of it can be curtailed by local exhausts, slatted table tops and floors, wet methods, improved methods, substitutes, and the wearing of light respirators. Particularly, should workers in the dusty processes be limited to those who give no personal or family history of tuber-

culosis. While the dust itself is non-poisonous and free from harshness, it excites coughing, which is all that is required to awaken tuberculosis in many persons with whom it would otherwise remain latent.

RUBBER.—COLD VULCANIZING.

This process is also called "cold cure" and "acid cure." It consists in dipping the articles to be vulcanized into various solutions carrying sulphur, or of applying the solutions to the rubber with a brush or sponge. Usually only a high grade of thin rubber articles unmixed with fabric are vulcanized in this way, such as gloves, cots, bags, etc., which are dipped into the solutions. We have also included here "splicing" of inner tubes for tires, in

FIG. 58. RUBBER "COLD CURE" PROCESS.

This room has slatted floor with exhaust beneath to draw off heavy poisonous fumes (carbon bisulphide, sulphur chloride, etc.)

which the solution is applied with a brush in the presence of a brief air suction blast, the worker standing before a small stand.

The process was investigated in 15 establishments, engaging 200 males and 3 females at this work. A welfare attitude seemed to prevail between employer and employe in 9 places and fairly so in the other 6. The workers were of an intelligent type in 10 places, and a fair type of foreigners in the remaining 5 (usually the larger places). It appeared difficult to retain workers at the process, especially in 5 places and fairly so in 9 others. Health appliances, consisting of exhaust systems locally applied, of confinement of the process within cupboards and good room ventilation were adequate in but 1 place, altho in 14 of the 15 places some attempts were made to control the

escape or concentration of the vapors. In all places workers were given gloves to protect their hands. Instruction concerning the poisonous solutions was good in 3 places only. The work day was between 9 and 10 hours in all places, with a noon recess of 1 hour in 3 places, ¾ hour in 1 place, and ½ hour in 9 others. In 5 places some overtime was the rule. The work required very little skill. There was a tendency to employ youthful persons. It was found to be a type of process in which persons were first introduced to the rubber business. Only 2 persons were seen over 40 years of age. Construction of the work quarters was hygienic in 8 places, fairly so in 4 others and bad in the remaining 3. In 8 places the work-room was only partially partitioned off from other processes, so that vapors and odors were interchangeable.

FIG. 59. RUBBER WORKS.

A carbon bisulphide dipping cupboard to the right, showing mechanical means of operating and dipping (carried on within cupboard) and the door to cupboard. Also slatted drying bench in center of room. Both this and the dipping cupboard are connected with a powerful exhaust system beneath the floor.

In 10 places soapstone and sulphur *dusts* were a fair hazard, due both to carelessness in their use and the absence of a removal system. In the remaining 5, dust was negligible. Quarters were *clean* in 7 places, fairly so in 7 others and not so in 1. *Dampness* was no factor. *Light* was good in 12 places and fair in 3. The room air was good in 1 place, fair in 8 and bad in 6, due to the escape of fumes and the absence of means for promoting ventilation. *Heat* was no factor, but *cold*, due to inefficient heating and to the wide-opening of windows in order to dilute the vapors and fumes was a bad factor in several places. *Fatigue* was a fair factor, due to the hurry of piecework, constant standing, faulty postures, and the youthfulness of many of the workers.

The contraction of *communicable diseases* was a bad risk in 3 places, fairly so in 10 more and negligible in the remaining 2. The hazards were common drinking cups, improper wash-places and closets, promiscuous spitting, absence of cuspidors, and lack of medical supervision. *Poisons* are the chief hazards in this industry. They vary in type and number, but include benzine, benzol, wood alcohol, carbon tetrachloride, sulphur chloride, and carbon bisulphide. The risk of poisoning was bad in 8 places, fair in 6, while in but 1 were we satisfied the workers were amply protected. In some places the work was done on table tops with brushes, the solutions being kept in open-top jars. In many places the drippings accumulated on the work stand and floors whence evaporation took place. Eating in the same quarters was the rule. A very few workers had been at the process more than a few weeks or months. Industrial *alcoholism* was favored in 3 places, partly so in 9 others, and was negligible in the remaining 3, the factors being inadequate drinking facilities, and the depressing influences of poisons inhaled, ingested and skin-absorbed.

In all places some workers were observed who were *unhealthy* looking, while in 5, decidedly pale and anemic persons were seen. The chief *complaints* of the workers were the breathing of the fumes and vapors and dust. In 9 plants the following cases of occupational poisoning were diagnosed: carbon bisulphide poisoning, 4 positive, 2 tentative and a number of suspicious ones; sulphur chloride and tetrachloride poisoning, 4 positive; benzol, 1 positive. In addition dermatitis, dyspepsia, and neurasthenia were frequent observations. *Comments.*—Out side of the use of mechanisms to confine fumes and to remove them, the workers should be examined weekly and rapidly promoted or rotated to other work. Females and youths under 21 should not be so employed. The liability among workers in carbon bisulphide to great physical and mental deterioration, including paralysis and insanity, the latter of both suicidal and homicidal characteristics, should be kept in mind.

RUBBER.—VAPOR CURE.

This process consists in exposing rubber articles, such as gloves, finger cots and drug sundries, to the vapors of sulphur chloride arising from a little of the substance placed upon a tin in a warming cupboard; also, largely used in some places in the splicing of the ends of inner tubes for tires, in which case carbon tetrachloride, and perhaps carbon bisulphide were additional substances used. (As this method of splicing tubes is done at room temperature, it has been considered under "Cold Vulcanizing.") The goods, except inner tubes, are exposed within the cupboards for the proper length of time and then removed, usually by hand. In most cases the workmen entered the cupboards for this purpose.

The process was investigated in 8 establishments in which 43 males were found to be so engaged. Foreigners constituted the main type of workers in 3 plants (all large places), while the balance were usually American-born. The men appeared to stay at the work well in 2 places, but only fairly so in the remaining 6. Health appliances consisted in confining the fumes within warming cupboards, having a hood and exhaust-pipe placed over the entrance thereto. In addition, the cupboards were, in some places, located within separate rooms, and had local exhaust systems provided to draw off vapors when the process was finished. The work day was 10 hours in all places, with ½ hour for noon recess in 6 places, and 1 hour in the 2 remaining. The workers

were only engaged at intervals in the process. The work required no skill on the part of the employes. All workers were between 20 and 40 years of age. Rooms containing cupboards were hygienically constructed in 7 of the 8 places. In 5 places the rooms were not well partitioned off, or were in the same quarters with other processes, such as dipping, specialty making and finishing.

Dust in the shape of soapstone and sulphur was a considerable hazard in 2 places, and fairly so in 3 more, the remaining 3 being satisfactory. *Cleanliness* of quarters was good in 1 place, fair in 5 and poor in 2. *Light* was not good in 2 places. The process required some heat, but in only 3 places could this be considered in a fair way detrimental. *Fatigue* was no factor. The contraction of *communicable diseases* was a bad risk in 4 places, fairly so in 2 others, and negligible in the remaining 2. The hazards were the use of common towels and cups, inadequate wash-places and closets, promiscuous spitting on the dusty floors, absence of cuspidors and lack of medical supervision. The *poisons* used by these workers were benzine, benzol, sulphur chloride, and carbon bisulphide. Sulphur chloride, however, was the only one usually concerned. Sulphur chloride itself is practically non-poisonous as used, since moisture is usually kept away from it. Otherwise the effects of chlorine and sulphur dioxide fumes would be noticeable. Industrial *alcoholism* was favored in 2 places, due, principally, to inadequate drinking water facilities.

In 3 places no unhealthy *appearing* workers were seen, while in the remaining 5, 1 or more were so. In 1 place workers *complained* of the effects of the fumes which caused coughing, sore throats and red eyes. *Comments.*—Arrangements should be made to withdraw the fumes before opening the cupboards and entering them; or, to counteract their effects, ammonia gas has been recommended.

RUBBER.—PRESS-ROOMS.

In these rooms, steam vulcanizing is done by means of steel presses, having hollow chambers through which the steam passes. The molds containing the rubber objects to be vulcanized (as water bags and drug sundries), are placed within the vulcanizers for the proper length of time. Such a vulcanizer occupies about 4 to 8 square feet of floor space, and stands about as high as the head. They are usually arranged in rows.

The process was investigated in 13 establishments, and engaged a total of 468 males and 64 females. The attitude of employer toward workers appeared excellent in 8 places, and fairly good in the balance. The workers were intelligent persons in 7 plants and a fair type of foreigners in the balance. In spite of endeavors on the part of the employers, retention of the workers at the process was only fair in 9 of the 13 places. Health appliances, consisting of asbestos coverings to limit the heat given off by the presses, cool air blasts and ventilating schemes were good in 3 places, fair in 3 others, and absent or inadequate in the balance. The work day varied from 9 to 10 hours in all places, with a noon recess of 1 hour in 4 places and ½ hour in 8. Overtime was sometimes resorted to in 4 places. The work requires comparatively little skill, except that practice engenders speed. The workers were preeminently between 20 and 40 years of age, with some under 20. The general construction of the workrooms was hygienic in 6, fairly so in 2, and bad in the remaining 5 places. Other processes were carried on in the same quarters in 5 places, and consisted of specialty work, trimming, cement mixing, packing, etc.

Soapstone *dust*, while present in all places, was a bad hazard in no more than 2. Much of this was due to the personal carelessness of the workers. Waste *accumulations* were bad in 2 places, and fairly so in 5, with the remaining, good. *Dampness* and *humidity*, due to escaping steam and water, was bad in 1 place, fairly so in 6 more, but was well controlled in the remaining 6. *Light* was good in 9 places, fair in 2, and bad in 2. The *ventilation* of the rooms was good in 3 places, only fair in 8 others, and poor in the remaining 2. *Heat* was a bad factor in 5 places, and more or less so in the remaining 8. *Cold* drafts from open windows, sendentary work, and heat or cold alternation was another common hazard. *Fatigue* was a fair hazard as the work was conducted in 9 places, due to piece-work, monotony, hurry, and the frequent lifting of heavy steel molds. The contraction of *communicable diseases* was a bad risk in 3 places, a fair risk in 8 others, and well controlled in the remaining 2. The risks were the use of common cups, improper wash-places and closets, promiscuous spitting, absence of cuspidors, lack of first aid provisions and medical supervision. *Poisoning* may be due in this process to benzine, benzol and, occasionally, antimony fumes from the rubber. In 9 places it was minimal, in 1 a fair risk, and in 3 a very bad risk. Open cups of benzine and of benzine and benzol cement were chief factors. Industrial *alcoholism* and coffeeism were decidedly favored in 5 places, and fairly so in 6 others, due to inadequate drinking water facilities, and the depression due to humidity, heat, fatigue and the fumes mentioned.

In but 2 places were all workers healthy *appearing*. In the remaining 11, one or more persons were at least in need of a physical examination to establish their health status. Pallor, anemia and exhaustion were the physical signs. The workers *complained*, principally, of the excessive heat in 5 places, which was increased in warm weather. Also the smell of burnt rubber and the benzine fumes. In 1 room the temperature was 120°. *Comments.*—The generous use of asbestos coverings to presses seems to be very efficient in preventing heat loss in the process as well as promoting a healthier atmosphere. Room ventilation schemes, local air blasts and aid-agitators are necessary appliances in most of the places. While some places were kept comparatively dry, and escaping steam was limited, others were at the opposite extreme. Plenty of room space should also be given.

RUBBER.—CEMENT MANUFACTURING.

This process, called "cement mixing", consists in the admixture of powdered rubber with benzine, benzol and carbon bisulphide. Sometimes one and sometimes all constitute the solvent for the rubber, with some other ingredients. The process, because of the risk of fire and explosions, is usually conducted at a distance from the other buildings in a small brick and stone outbuilding. In some places, however, no such precautions were observed. The mixing may be done by hand in open containers, using a wooden paddle, or by machinery. After the mixing, the cement is drawn off and usually filled by hand into compressible tubes and cans to be sold, except that to be used at the plant itself, which is placed in five-gallon open or closed cans, and distributed to the various departments.

The process was investigated in 9 places, where it engaged 50 wage-earners, all males. Mechanical methods of good protective character were present in 5 places, while, in the other 4, antiquated methods were in vogue.

The attitude of employers toward workers seemed good in all places. The workers were very largely foreigners and appeared to remain but a short time in most of the places. Health appliances, consisting of mixing machines, which confined the fumes by local down draft exhaust systems at the places of drawing off the cement, and of room exhaust fans, were adequate in 2 places, fairly so in 4 others, and absent in the balance. The foreman seemed well informed on the danger of poisoning in only 3 of the 9 places. Usually the danger was considered as a matter of course. The work day consisted of 9 to 10 hours in all places, with 1 hour for noon recess in 1 place, and ½ hour in the other 8 places. No particular skill was required in the process. But 2 workers were observed over 40 years of age. On the other hand, a con-

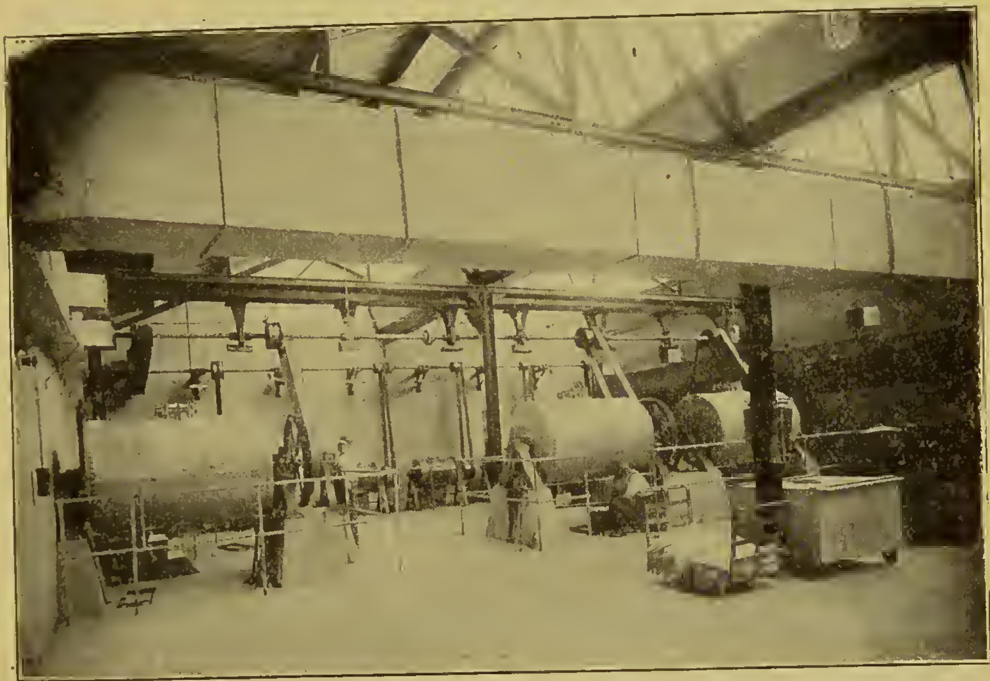

Fig. 60. Mixing Rubber Cement.

Poisonous solutions and fumes are confined within rotary mixers. The room has exhaust floor vents along the edges, and fresh air is forced in continually from pipe openings along walls overhead.

siderable number of boys were employed, this being their first introduction to the rubber business in some places. The construction of the workplace was hygienic in 7 places, fairly so in 1, and bad in the remaining. The process was carried on in an open, hand method in the same room with other processes in 2 places.

Dust was hardly a factor in the process. Quarters were *clean* in all but 1 place. *Dampness* was no factor except that in outdoor buildings adequate heating was absent. In only 2 places was the *air* safely freed of the fumes and vapors. The balance were badly in need of local exhaust ventilation schemes, particularly in the filling of tubes and cans, which was usually done by boys, working around a table. *Cold*, from the outdoor character of the

work, was a bad feature in 1 place. *Fatigue* was no factor. The liability to contracting *communicable diseases* was a factor in most places, due to the use of common drinking cups, improper wash-places and closets, promiscuous spitting and absence of cuspidors. The risk of *poisoning*, depending somewhat upon the carelessness of the operator himself, was present in all places. In 4, however, protection was by no means adequate. The chief poisons were benzine or naphtha, benzol and carbon bisulphide. Industrial *alcoholism* was well controlled in 3 places by providing adequate drinking facilities, and taking care of the fumes as well as giving personal instructions.

No *sick* workers were observed in 3 places; in another, all were new employes, while in the remaining 5, several persons, as a rule, were in need of a medical examination. The *complaints* of the workers were dizziness, nervousness, loss of appetite, easy fatigue, coughs, sore eyes and other symptoms of the fumes named. Many workers refused to remain more than a day or 2. Some were seen who had been so employed for a number of years, but, of these, few were healthy appearing. *Comments.* — Every mechanical effort should be made to confine and remove fumes. In addition, workers should have a frequent medical examination, and they should be rapidly promoted, or frequently rotated to other positions. The liability to paralysis and insanity among workers exposed to carbon bisulphide has been mentioned under "Cold Vulcanizing."

RUBBER.—RECLAIMING.

By various chemical and mechanical processes old rubber is reclaimed from waste products about the rubber works and from vast quantities of old rubber goods which are shipped in. It is a special industry by itself. The process consists in grinding, milling, chemical treatments and drying. The finished product is called "shoddy".

The process was investigated in 6 plants employing a total of 532 wage-earners, all males. The plants varied from 18 to 350 wage-earners. A vast majority of the workers were foreign-laborers who had a tendency to come and go. Adequate health appliances were found in 3 places, fairly so in 1 more, and not so in the remaining 2. The work day varied from 10 to 12 hours; the noon recess was ½ hour in all places. Most of the workers were pretty steadily engaged at their various applications. Very few workers were under 20 or over 40 years of age. The plants were hygienically constructed in 2 places and not so in 3. A general jumbling of processes, usually to the detriment of health, was observed in 3 places.

Dust, consisting of lint, shoddy and rubber, was a bad factor in 1 place, fairly so in 2 others and no hazard in the remaining 3. *Cleanliness* was good in 3 places, fair in 1 and bad in 2. Protection from water, steam and *humidity*, which are essential features of the process, was good in 1 place, fair in 3 others, and bad in the remaining 2. Half of the places were poorly *lighted*,— large numbers of men worked in basement-like rooms barely lit with flaming gas jets. In 2 plants, however, light was excellent throughout. The general *aerial* condition of the work rooms was good in 3 plants, fair in another and poor in the remaining 2, due to the lack of control of vapors and fumes and the absence of ventilating arrangements. *Heat* was no particular factor in 3 places, but was bad in 2. Exposure to *cold* and drafts were frequently bad for men who went in and out of hot quarters. *Fatigue* was not much of a factor since the workers were usually well selected to laborious processes.

The contraction of *communicable diseases* was a bad risk in 1 place, fairly so in 2 others and negligible in the remaining 3, due to inadequate washing places and closets, common drinking cups, promiscuous spitting, absence of cuspidors and lack of medical supervision. The *poisonous substances* used, mineral acids and alkalis, were well enough confined in 3 plants to constitute no hazard and fairly so in the remaining 3. Industrial *alcoholism* was rather favored in all plants, and especially in 2, through the lack of adequate drinking water facilities.

The appearance of the workers was good in 3 plants, while in the remaining 3 some workers were seen who were not *healthy appearing*. No health complaints were obtained from any of the employes, altho the inability of large numbers to speak English considerably hindered such inquiries. *Comments.*—The grinding up of old rubber should be hooded and exhausted to limit the dust, which, it must be remembered, is oftentimes rich in lead. Also more attention should be given to providing the workers with rubber boots and aprons who are employed at the watery and steamy processes. Those in hot, damp work should be given the privileges of shower baths, with change rooms and lockers in which to dry work clothes and keep their street clothes separate.

POTTERY.—SLIP MAKING.

Processes in the so-called slip houses are, in general, as follows: removing the clays in the form of dust and lumps from the stock bins, grinding, water-washing and sifting processes, the preparation of the "slip" (as the liquid form of the clay is known), in blunging mills, pug mills, agitators, compressing machines and drying kilns. In the larger and better arranged plants, several of these sub-processes were in rooms or quarters by themselves, or arranged on different floors, but in the majority of instances all were carried on usually in a basement or first floor room.

The process was investigated in 38 plants (24 Whiteware, 7 Stoneware, 4 Artware, and 3 Tile plants) employing a total of 214 wage-earners, all males. Even in large plants but a comparatively few persons are employed in this part of the industry. Modern methods appeared to exist in 16 places, fairly so in 20 others, and not so in the remaining 2. Twenty-three were union plants and 15 non-union. Evident interest in workmen's welfare was excellent in 10 places, fair to good in 24 more and not so in the remaining 4. The type of workers was good in 30 places and fair in the remaining 8. The work was unskilled, or, at the most, semi-skilled labor. The majority of the workers appeared to be fairly steady employes in 20 places, and not so in the remaining 18. Special health appliances were good in 1 place, fair in 2 others, and practically absent in the remaining 35. Placards and organized instructions along health lines were absent in all places, as were also sick benefit, death and pension features, except such as were maintained by the unions. Work quarters were hygienically constructed in 4 places, fairly so in 5 others, and not so in the remaining 29. In 7 plants other processes, such as clay molding, finishing and glaze-mixing were carried on in the same quarters with slip making. Of the total number of workers, 20 were over 40 years of age and the balance between 20 and 40.

The work was so conducted that in 9 places *dust*, composed of a small percentage of flint and the various clay earths used (and non-poisonous), was no hazard; in 6 others it constituted a fair hazard, and in the remaining 23 it

was bad. The chief causes for dust in the atmosphere were the more or less constant shoveling of the clays in a dry form, its escape from grinding machines, and from "kicking up" from the floors. In 3 places quarters were maintained excellently *clean* and orderly, especially for a class of work such as this; in 9 other places general cleanliness was from fair to good; in the remaining 26 the word "cleanliness" could hardly be said to apply, inasmuch as many of them were located in basement and cellar quarters, with clays in both wet and dry form covering the floors. In many places it seemed difficult even to move about because of the uneveness of floors and platforms, the piles of clay, the crowding of machinery, vats, partitions, posts, low ceilings and the like. Water and *dampness* were well enough controlled to constitute no hazard to health in 8 places, and fairly so in 10 more, but not so in the remaiing 20. This seemed to be due to faulty floor drainage, leaky vats and slip-containing

FIG. 61. THE SLIP HOUSE.
Showing presses where water is squeezed out of the "slip".

machines, and the presence of the wet clays under foot, as well as quarters which it would be hard to keep from dampness under any circumstances. *Light* was good in 14 places, fair in 3 more and bad in the remaining 21, due, chiefly, to the confined location within basement or ground floor rooms, many times practically shut off from daylight. In such quarters flaring gas flames burning at the end of a pipe and without vents to remove fumes were frequently the main source of light. General room *ventilation* was excellent in 2 places, fair in 17 more, and bad in the remaining 19, due, chiefly, to inside, basement, or cellar locations, the presence of dry kilns, of heating and lighting processes without adequate vents for gases and fumes, and to the absence of ventilating machinery or appliances in places where doors and windows could not be counted upon for proper ventilation. Hot, still, humid air was a common observance in many places, and cold, still moist air in others. Workers often passed from the one to the other. *Heat* was a negligible hazard in 21

places, fairly so in 10 others, and bad in the remaining 7. The chief causes of heat were hot processes, particularly the exposed location of drying kilns. While *cold* is not a feature of the process, the work quarters, although inspected in the summer time, were hazardous in this respect in 5 places and fairly so in 3 others. The proportion would unquestionably be higher in the winter season. In the majority of places, however, heating arrangements were extended to the slip houses, or the processes themselves insured the same. A considerable part of the work is of a heavy, arduous character, and for this reason the more powerfully built types of laborers were usually found present. However, *fatigue*, to the extent of exhaustion, was a hazard in 27 places, the chief factors being the continual lifting of heavy clays and "slips", piece-work in some places and constant straining postures. The workday was 8 hours in 3 places, from 8½ to 9 hours in 4 places, and from 9 to 10 hours in the remaining 31. The noon recess was 1 hour in 6 places, ½ hour in 17 others, and less than a half hour in the remaining 15. Sometimes the men apparently worked without observing any particular noon recess. Overtime was an infrequent occurrence. A morning lunch recess at 9 o'clock was a common observance. The liability to contracting *communicable diseases* was a bad hazard in 29 places and fairly so in 8 more, due, chiefly, to promiscuous spitting, absence of cuspidors, use of common drinking cups, inadequate washing facilities, poor closets, lack of lockers and of medical supervision. In many places first-aid provisions were inadequate or lacking. *Poisons* were no feature of the process, but in many places these workers were more or less exposed to the dusts from the glaze-mixing machines in the vicinity where lead compounds were being group up and mixed. The inducement to *alcoholism* was considerable in 26 places and fair in at least 6 more, due to inadequate drinking water facilities and the depressing influences of dampness, laborious work, disorderly surroundings, devitalized air and the like.

The general *appearance* of workers was good in 8 places ,while it was generally no more than fair in the remaining 30. Many prematurely aged, pale and under-weight men were seen among those longest employed. The chief *complaints* of the workers were the breathing of dust, damp quarters, heat, fatigue, poor washing facilities and general insanitary quarters. *Comments.*— Except the breathing of dust, there is nothing about this process which is inherently hazardous to health. All features dangerous to health come under the head of general sanitation, ventilation, light, heat, water and dampness control. The various figures above given show the proportion in which these features were not up to a standard sufficient to conserve the health of the workers.

FLINT DUST MAKING is the most hazardous dust process in the pottery industry. Only a few large firms did this for themselves, but our attention was called to two firms employing foreign laborers who were engaged in making this product. Crushing, grinding, conveying, and packing all created an unusual amount of fine, hard flint dust which pervaded the air of the "houses" and even coated the openings of windows, doors, and roof vents with a white flour-like powder. *Comments.* — Dust-confining machinery, short hours, and respirators are needed in all such places.

POTTERY.—SAGGER MAKING.

This process consists in the making, shaping, baking, finishing and repairing of the clay containers in which the pottery ware itself is later baked. It was investigated in 19 plants where 1 or more men were practically steadily so employed, the total number of wage-earners being 106. From this it will be seen that a comparatively few potters are engaged in sagger making. The plants investigated were white-ware, tile and art potteries. Fifteen were union plants and 4 non-union. The type of workers was generally good, the work requiring some skill. Retention at the trade appeared good in 13 places and fair in at least 5 more. Health appliances and instructions along health lines were given some consideration in 1 place. The construction of the work place was good in 4 places, fair in 2 others, and hygienically bad in the remaining 13. The process was usually carried on in close proximity to the slip making quarters. There were 8 workers over 40 years of age, the balance being between 20 and 40.

Fig. 62. Sagger-Making Room.
Saggers hold the ware while being fired in the kilns.

The work was done so as to keep *dust* at a neglibible minimum in 4 places, fairly so in 5 more and not so in the remaining 10. The chief cause of dust was the careless handling and dumping of clays and the "kicking up" of it from the floors and benches. Quarters were in *clean* condition in 2 places, fairly so in 6 others, and not so in the remaining 11. *Dampness* was negligible in 8 places, fairly so in 3 more, but constituted a hazard to health in the remaining 8, due to water, steam, humidity, and in some places, basement or cellar locations. Others hazards of *light, ventilation, heat, fatigue,* and the liability to *communicable diseases,* were about the same as those described in "slip" making. One other great hazard was noted, viz., "sagger washing", which consists in the painting of the inside of the saggers with a red lead solution. Among the 20 men found so employed were 3 cases of chronic lead *poisoning* and 1 other who had had acute lead poisoning.

The *appearance* of the sagger makers in general was good in 5 places, while 1 or more sickly appearing workers were seen in the remaining places. General *complaints* were breathing of dust, dampness, rheumatism, and poor sanitation. *Comments.*—The lead poison hazard of sagger washers is largely

one of personal hygiene, plus the fact that in numbers of places there were no washing facilities, that workers did not know that red lead was poisonous and that periodic medical examination for the slow onset of lead poisoning were lacking. The improvement of general working conditions was needed in from ½ to ⅔ of the places to insure the health of the workers, particularly, along the lines of dampness prevention, cold drafts alternating with heat exposures, poor closets and the like.

POTTERY.—MOLD MAKING.

The making of plaster-of-Paris molds for forms for china ware, art ware, etc., is a feature employing 1 or more men in each pottery. The process was investigated in 16 plants where 37 men were more or less constantly employed at mold making. Health appliances to handle and confine the dust mechanically were absent in all places. The men were old employes in 9 places, and remained fairly steadily at the work in the remaining 7. The work place was hygienically good in 2 plants, fairly so in 6 more, and not so in the remaining 8. The work was usually carried on in quarters by itself. There were 9 of the 37 workmen who were over 40 years of age.

FIG. 63. MOLD MAKING.
A process resembling sculpturing.

The *dusts* were so handled in 6 places as to constitute a fairly negligible hazard, but in the remaining 10 this was not so. The chief factors were the emptying of barrels of plaster-of-Paris and the handwork with the same. Piece-work caused too much hurrying and too little care in the amount of dust created. Quarters were kept *clean* and orderly in 4 places, fairly so in 7 more and not so in the remaining 5. *Dampness, darkness, heat, cold,* and *fatigue* were negligible features in all but 1 or 2 places. General room *ventilation* was good in 5, fair in 8, and poor in 3 places. The liability to the contraction of *communicable diseases* was a considerable hazard in 13 places, due to promiscuous spitting, absence of cuspidors, common drinking cups, inadequate washing facilities, poor closets, and lack of medical supervision. *Poisons* were not used.

The general *appearance* of workers was good in 6 places, while 1 or more in the remaining 10 appeared under par. The *complaints* of the workers were the breathing of dust and general features of sanitation. *Comments.*—It would appear that mechanical means could be contrived to convey and weigh

the dusts used, particularly, where piecework obtains. Being a dusty occupation and an injurious type of dust, workers should be under medical supervision. In addition, respirators should be furnished and worn while performing unavoidably dusty operations in the work.

POTTERY. — CLAY OR BISQUE MAKING.

The clays which are prepared in the "slip" houses are conveyed to the clay or bisque making rooms where they are shaped on plaster-of-Paris molds or otherwise by various groups of workers and with the aid in some instances of simple machinery. In tile and porcelain factories the work is done by machines in what are known as the pressrooms. The workers include batters-out, pressers, jiggermen, jollymen, turners, handlers, stickers-up, dish specialty makers, finishers, machine pressers, mold boys (called also mold runners and dog trotters), and helpers. Of these classes females were employed par-

FIG. 64. A LINE OF JIGGERMEN IN THE CLAY HOUSE.
Here plates are formed.

ticularly as finishers and in the making and putting together of small parts. After the ware is shaped it is placed on board trays and carried into drying ovens located usually a few feet to the backs of the workmen. The mold boys do the carrying of the ware and the filling and emptying of the ovens, which they enter and climb up to the upper shelves as required to reach them.

The process was investigated in 53 plants, including all branches of the pottery industry. It was skilled work in all except machine processes (tiles and porcelain ware). There were employed a total of 3,048 wage-earners, of whom 2,521 were males and 527 were females. The majority of all potters are engaged in the bisque making rooms. Unions existed in 33 of the plants investigated and were absent in the other 20. The general attitude towards employes seemed fair to good in all but 4 places. The relations between employer and employes are peculiar in this process: while the older and skilled men work for the company, a large percentage of the total employes, composed principally of boys and females and some adult male helpers, are em-

ployed by the skilled workers. The type of workers was of an intelligent class in practically all places. Non-English speaking persons were rarely encountered. The question of how well workers remained at the various processes is probably best answered as in direct proportion to their skill. As the unskilled outnumbered the skilled and as apprentices were selected from among the former, there was considerable rivalry among helpers, — enough to keep most of them intensely busy. In but 3 places were features which could be considered as health appliances present, and these consisted in 1 place of air exhaust fans for the work quarters, of mechanical mold and "green ware" carriers in 2 places, and in cuspidors and garbage cans in some places. Some instructions along health lines were given in 3 places. Outside of the unions very few of the workers had sick, death, or pension benefits. Work quarters were hygienically well constructed in 4 places, fairly so in 11 others, and not so in the remaining 38. The chief features were due largely to the old types of factory construction, with low ceilings, inadequate window space (particularly for room interiors), rough floors, half floors, lofts, "chopped-up"

Fig. 65. Pressing Department in Clay House.

quarters, poor heating facilities, and so on. In most places the clay rooms were on several floors, one above another, or scattered about. The mass of workers were at benches before the windows from which boys and helpers transported the ware to the baking ovens which occupied the centers of the rooms, and were usually heated by gas or steam and without vents to remove the motionless heated air from the rest of the room. At about ¼ of the places other processes, as the making of "slip" or saggers, and dipping, were done. Age-group estimations summed up as follows: 32 persons over 50 years of age, 256 between 40 and 50, 2,482 between 20 and 40, and 278 under 20, the latter, boys, as a rule.

In 3 plants the work was performed and supervised in such a way that *dust* was a negligible hazard to workers, and in 10 more such was the case to a fair extent. In the remaining 40 places, workers were under considerable hazard from the breathing of fine clay dust in the air. Some machine pressrooms were free from dust; others were very dusty, apparently because clays were handled drier. In these, each fall of the press was accompanied by a discharge of dust. While the clays are handled in the wet, as the process proceeds they become dry until they are eventually baked. Carelessness and

hurrying work at the benches creates some dust, but most of it arises from clap drippings which dry out on the floors, from the carrying trays, from the continual hurrying trips of the mold boys, and particularly, from the finishers. The *finishers* (largely females) who scrape rapidly revolving articles, ran the greatest dust hazard, while the mold boys and helpers who handled the dried bisques in the ovens suffered next in hazards. In no places were local exhaust systems found for the protection of finishers. If the dusts were not of an injurious character the risks to the general mass of workers could be overlooked. Quarters were orderly and *cleanly* in 6 places, fairly so in others, and not so in the remaining 41. General construction was a chief factor in such, rendering it impossible to use a hose for cleaning floors and benches or to use

FIG. 66. PRESSROOM IN AN ART TILE WORKS.

The machines (on right) press the moist clays into tiles, the workers select and "sagger" them. The workers are not crowded as foreshortening by camera appears to show.

vacuum cleaners. While the work is necessarily with wet and moist clays, still, *dampness* was a negligible hazard in 21 cases, fairly so in 7 more, but not so in the remaining 25, in which latter poor locations and insufficient heating provisions (other than the baking ovens) were the chief causes. Carelessness on the part of the workers was another factor. *Light* was good in all places for the more skilled workers, but in ⅓ of the places, a large percentage of those engaged in sub-processes were in very poorly or improperly lighted quarters. General room *ventilation* was good in 11 places, fair in 14 more, and poor in the remaining 28, particularly, for the winter season of the year. This was due to the large number of work people assembled together, the presence of the baking ovens, and the lack of air-agitators and air-conditioning systems, and often to the absence of ordinary vents in types of buildings which it was

impossible to ventilate efficiently without mechanical means. *Heat* constituted no particular hazard to workers in 24 places, while it was some feature in 6 places, and bad in the 23 remaining, particularly, in the warmer seasons of the year. The presence of the baking ovens accounted for this. While the mold boys remained in the ovens for only a few minutes at a time, the investigators found them to be very hot, especially for youths who worked at such a hurrying pace as was commonly observed. *Cold*, due to the presence of the wet clays and insufficient heating arrangements, was a considerable complaint in 26 establishments during the winter time. Many persons said they worked with hands and arms benumbed and the feet cold at the benches during this season. The alternations between heat and cold for the oven workers was another frequent complaint. *Fatigue*, especially for youths, constituted a fair to considerable hazard in all handwork places. It was chiefly due to hurrying piecework, monotonous application under constant strain, constant standing (very rarely were females, even, found to be seated), and faulty postures. Less frequent factors were for some of the classes employed: laborious work, long hours, and pressing various portions of the body against objects to facilitate

FIG. 67. "GREEN" ROOM.
Where the ware is dried before firing.

the work. Chairs with backs (for females) were rarely observed. Many workers had formed the pernicious habit of leaning over their work which was oftentimes of a dust-producing character. This was explained by some workers as due to the lack of an apprenticeship for the first week or 10 days during which workers could learn their manipulations in a proper and safe manner. The workday averaged 8 hours in 4 places, between 8½ and 9 hours in 5 places, between 9¼ and 10 hours in the remaining 44 places. The noon recess was 1 hour in 11 places, ¾ hour in 1 place, ½ hour in 19 places, and was "as desired" in the remaining 22. In the majority of places a morning recess of 10 or 15 minutes was the custom. The liability to the contraction of *communicable diseases* was present in all places, but constituted no more than a fair hazard in 10 places. The chief factors were the crowding together of large numbers of workers whose health status was unknown, and without medical supervision. Added to these were inadequate washing facilities, poor closets (sometimes at great distances and perhaps only privies out in the yards), promiscuous spitting, absence of cuspidors, the use of common drinking cups, and the constant presence of dust to help in the conveying of

diseases, and in the injuring of the respiratory organs. *Poisons* were not a feature of the process, but there was considerable complaint from the fumes and gases from the ovens in many places. In very few places was the industrial inducement to *alcoholism* and various forms of stimulantism absent, because of the depressing influences above stated.

In 10 places the general *appearance* of the workers was good and contented. In the balance many fatigued, underweight, and general under-par individuals were seen. The usual *complaints* of workers were heat, fatigue, dust, poor ventilation, dampness, and cold. This is the chief process (because it employs so many) in the pottery industry from which consumptives come, and many instances of this disease were brought to the attention of the investigators by both workmen and employers, usually with the information that it was unavoidable. *Comments.* — Among the shortcomings pointed out in the discussion above are to be emphasized hurrying piece-work in a hot-and-cool atmosphere, especially for youths, and the lack of a physical examination for all employes, in order, especially, to get those who are consumptive out of the workrooms and to forewarn persons so disposed. It must not be forgotten also that pneumonia is a frequent occupational disease among mineral and clay dust inhalers. In many places hoods and stacks or roof ventilators could be placed over the oven quarters. Smooth floors, frequently wet-cleaned or vacuum-cleaned, are necessities. It would appear to be much better to have the factory management take care of cleaning up the work quarters than to leave it to each worker to attend to his own. — Those who question the presence of fine dust in the breathing atmosphere should expose a shallow pan or dish, colored dark on the inside, at the level of the workers' heads, fill it with water and after an interval evaporate the water to note the presence and amount of deposit.

POTTERY.—GLAZE MIXING.

This process consists in the weighing, mixing together and fritting of materials for glazing the molded ware. While some glazes used contain no oxides and salts of lead, the vast majority of them do. All the forms of lead used are harmful. The glaze mixers handle the lead oxides and salts in their original form, and hence run considerable risk of lead poisoning because of the dustiness and solubility of the lead ingredients. While fritted lead glazes (the lead added before the fritting is done) greatly reduce the solubility, this feature concerns the glaze-dippers who later use it, rather than the glaze mixers who prepare it.

The process was investigated in 16 plants where men were more or less constantly so employed, including 12 whiteware, 3 artware, and 1 stoneware plants. There was a total of 24 wage-earners, all males. From this it will be seen that glaze mixing even in large establishments does not require more than 1 or 2 workers. The general type of workers was good in 13 places, and fairly so in the remaining 3. In 10 places the workers had been at the process for some time, while in the remaining 6 they were recent employes. In no places were special health appliances observed, while in but 2 was any definite instruction apparently given to the workers upon the dangers of lead poisoning. However, each worker had some indefinite idea, as a rule, that the substances he was handling were poisonous, but his knowledge on the avoidance of poisoning was usually very imperfect. The work requires no particular skill. The

glaze mixing quarters were commonly in association with the slip house or sagger quarters. But 3 of the workers were over 40 years of age, while no youths were seen.

In 1 place *dust* was well enough confined and controlled to constitute practically no hazard, and in 4 more places it was but a fair hazard, while in the remaining 11 it was bad, considering its nature. The same proportions obtain as to the general *cleanliness* of the quarters or room in which the work was done.

The workers were healthy *appearing* in 2 places, fairly so in 12 others, and not so in the remaining 2. The workers' *complaints* were the exposure to dust and the general insanitary character of the work quarters (see "Slip" Making). Of the 20 men seen, 2 were suffering from lead poisoning and 3 others tentatively so. *Comments.*—Where dusts, particularly of poisonous character, cannot be controlled in their handling and manipulation by confinement or by exhausts locally applied, the worker should wear a respirator while so exposed, and cleaning of quarters should be done either in the wet or by

Fig. 68. Glaze Mixing.

vacuum methods. However, general sanitary provisions, instructions on the preventing of lead poisoning and periodic medical supervision are essential for this process.

POTTERY.—GLAZE DIPPING.

This process consists in taking the bisque ware (occasionally the green ware) and dipping it into a glaze solution, the chief component of concern being lead in some form. For some artware and tiles subsequent glazings are done by brush painting, sponging, and mottling. The colored glazes are the richest in lead compounds. Some of the glazes used contained no lead, especially for certain special ware (porcelain, stoneware, and some tiles). The vast majority of the glazes contained lead in an unfritted form (especially soluble in the human gastric juice if swallowed). Water constituted the solvent or medium for the glaze. The dipping was done by hand in all except a few processes in tile factories where small and regular pieces were dipped by machinery. However, it was said that hand dipping was rapidly disappearing in tile factories. After glazing, the ware is placed in saggers and baked in the glost kilns.

The dipping process was investigated in 53 plants, employing 329 males and 257 females, or a total of 586 workers. In all except a few instances the dip-

ping was done by males, while females acted as helpers in draining, wet finishing, and rubbing of the glazed ware. In many instances females or boys acted as "gatherers", and removed the ware from the dipping quarters. Tiles were usually placed in the saggers while still wet (hence, not dusty). Unions existed in 34 of the plants investigated and were absent from the remaining 19. In some cases helpers belonged to the unions. The helpers were usually hired by the dippers and constituted a fair to good type of unskilled help in practically all places. While the dippers themselves were long-time employes, as a rule, a large percentage of helpers had worked less than a year in nearly all places. This was mostly due to varying social conditions, and sometimes to sickness. They changed about considerably from plant to plant. Special health appliances (outside of mechanical means for dipping in the tile works, and room exhaust fans in one place) were not found, although cuspidors and special methods of cleansing the floors by frequent flushing into floor drains were features in a small percentage of places. A very few places provided lunch

Fig. 69. Dipping Room.
Here the fired and finished bisque ware is dipped in the glaze.

rooms and occasionally these were most uninviting and not kept clean, and consequently were little used. Some instruction in the prevention of *lead poisoning* was given the workers in 5 plants. A number of plants were undergoing remodeling at the time of our investigations. Except for the benefit privileges kept up by some of the union locals, none of the workers were protected by organized sick insurance. The general construction of the work quarters was hygienically very good in 7 places, fair in 11 more, and not so in the remaining 35. Other processes were carried on in the glaze room in 12 places, such as glaze mixing, glost and bisque kilning, clayshop work, finishing and decorating.

At first glance very few dipping quarters appeared *dusty*, but when one considers that glaze dust usually contains lead, the mere trace of dust, produced even at intervals, becomes a decided health-hazard. As all dipping and finishing is done in the wet, all dust is the result of carelessness and hurry on the part of the workers from splashing upon the floor, upon benches and

boards, and upon the clothing, and allowing it to dry, whence it "kicks up" as a fine powder, hardly visible to the eye perhaps, but enough in amount to cause lead poisoning by settling on the lips, and by inhalation. In 4 plants dust appeared to be absolutely controlled. In 23 others it was kept down enough to constitute only a fair hazard, but in the remaining 26 the possibility from poisoning from this source was great. The floors and work benches were kept very *clean* in 10 places and fairly so in 21 more, but not so in the remaining 22. In several places dried glaze was allowed to cake on the floor under foot. Cement or other impervious floors with drains, and capable of frequent flushing, were installed in all the clean places. Although dipping was done in a watery solution, water and *dampness* were no hazard in 27 places, and but fairly so in 12 more. In the remaining 14, workers were engaged in injuriously

FIG. 70. HAND GLAZING OF ART, FLOOR AND WALL TILES.
The men do the glazing or dipping; the girls do the finishing or fettling in the "wet" over pans of water.

damp quarters. *Light* was good in 27 places, fair in 11 more, and poor in the remaining 15. Occasionally work was done in inside rooms under a flaring gas flame burning at the end of a pipe. The *ventilation* of quarters was fair to good in 37 places, and poor in the remaining 16, due to confined quarters. *Heat* is no factor in the process, but in 9 places it was very warm, due to proximity to kilns. In 4 places strong complaint was made of *cold*, damp quarters, and in a total of 16 complaint was made about inefficient heating in the winter season. Some dippers claimed that the solutions became so cold that they worked with hands and arms "half frozen" in the winter time. Drafts were usually purposely avoided, to keep out street dust; on the other hand, in some plants, windows were allowed to be open. *Fatigue* is largely a question of how well the individual worker is adapted for the work he or she is perform-

ing, for although hurrying piecework was the rule in practically all plants except artware, the hours were sufficiently short and recesses frequent enough for most of the workers. The workday was 8 hours in 3 places, and varied between 8½ and 10 hours in the remaining, the workers usually leaving when a certain output had been accomplished. Thus, many of them got through as early as two o'clock in the afternoon. The noon recess was 1 hour in 13 places, ¾ hour in 1 place, ½ hour in 20 places, and "as desired" in the remaining 19. A morning lunch recess at about nine o'clock was observed in nearly all places. Outside of piece-work, the chief factors conducive to *fatigue* were monotonous dupliation of movements and constant standing. This was worse for the dippers than for the helpers, who had opportunities to change positions with greater frequency. In practically all places, except machine dipping in tile works, workers, including females, remained standing constantly. In porcelain

Fig. 71. Machine Glazing of Art, Floor and Wall Tiles.

works and in 1 or 2 stoneware works females (unskilled) were doing the dipping. The constant leaning and awkward postures which many workers assumed were also bad features. The liability to the contraction of *communicable diseases* was practically no hazard in 8 places, but in the remaining 45 there were observed the usual dangers, such as promiscuous spitting, the absence of cuspidors, absence of proper washing facilities, poor closets (in several places only outside privies), common drinking cups or the drinking out of jugs and bottles by several persons, crowding together, the short intervaled handling of ware, and the lack of medical supervision. The liability to slow *poisoning*, due to lead and occasionally to manganese, antimony, arsenic (?), and chrome colors, was well enough circumvented to constitute no hazard in 5 places, and fairly so in 7 more, but in the remaining 41, the danger existed. There was a possibility of "zinc chills" in 1 place where zinc glaze was fired at

high temperature. Poisoning was almost altogether a question of personal carefulness, but many managements were at fault in not providing adequate wash-places, eating quarters away from the dipping rooms, and, especially, close supervision of ignorant or careless workers. This latter failing was largely due to the sub-contract system in vogue, by which dippers hired their own helpers and also were supposed to look after the cleanliness of their own quarters. As a result of this, the responsibility for cleanliness was too much "everybody's business". As might be expected from those engaged at piece-work, different standards of cleanliness prevailed. All such workers should wear special clothing, including caps for the females, and it is hard to see why these should not be supplied and kept clean and in repair by the managements as is the custom in certain other lead and poisonous industries. In tile works girls were found to be supplied with finger cots. It is probable that workers were given a false sense of security from washing-up in barrels of water which were usually placed under a cold-water faucet and a steam pipe from which to get steam for hot water. The wiser ones used a tin-basin. Such barrels readily became a solution of lead water after the first few hours of their filling. Machine dipping in tile works seemed entirely devoid of risk since there was no need for splashing; after that poisoning from handling the unbaked glaze was largely a matter of personal carelessness. The inducement to *stimulantism* should not be great in this process, because of the relatively short hours, but as the least amount of lead in the human sysem creates a desire for stimulants, the risks can be appreciated. Industrial alcoholism also exists with a certain small percentage of these workers who like to believe that alcohol counteracts the lead. From a medical and physiologic point of view such an assumption is of course preposterous.

In 11 plants all the workers in the different rooms were healthy *appearing*, but this was largely due to the newness of many of the workers to the process. In 34 plants 1 or more were seen who were under par, while in the remaining 8 plants a number were seen who were decidedly sickly looking. The principal *complaints* of the dippers and their helpers were the lack of proper provisions to keep down dust, the poor washing facilities, and lack of dependable instructions on the prevention of poisoning. Here and there just complaints were made covering almost the entire field of sanitation and hygiene. The investigators were particularly struck with the large number of skilled dippers who were healthy appearing and had been at the process for years. This was explained best by the fact that these men had learned how to keep lead dust out of their mouths and from the vicinity of their breathing. Such workers were invariably found to be very strict, usually well posted, and many of them lamented that they could not impress precautions upon their helpers. The helpers, however, were less able to protect themselves. There was also a tendency among many to belittle the danger of lead poisoning, due, apparently, to alleged difficulties in securing life insurance and also in securing helpers. In 29 plants our investigators came across 28 cases of positive lead poisoning, 20 cases of tentative lead poisoning, 9 persons who had had lead poisoning in the past, and a considerable number of "hearsay" cases. Some of these were investigated, and 2 or 3 persons found who were at home suffering from lead palsies and the like. *Comments.*—We believe that the placarding of all these quarters with instructions to workers upon "How to prevent lead poisoning", would prove a big feature in preventing it. Fortunately, lead does not enter the human body

through the skin, and it would seem to be fairly easy to keep it out of the nose and mouth. *Keep down the dust* and keep everything which goes into the mouth free from the least suggestion of glaze and there would be no lead poisoning. An ideal plan would be health placards, health instructions, the investigation of every case of sickness by a competent physician, prompt discipline for infraction of health rules, janitorial service provided by the managements (as was done in some places), special work clothes, aprons and caps, a place outside of the dipping quarters to keep street clothes and lunches, good washing facilities (including soap, individual towels, nail files or brushes, and individual wash basins where running water can not be secured), a place to eat outside of the dipping rooms, the drinking of milk for breakfast, morning lunch and noon lunch, and the adoption of all methods to keep the glaze from dripping onto the floors (brush on inside edge of tub, drain boards dripping back into tub, dark floor to show up drippings, carrying boards kept moist or belt carriers, etc.). With these precautions we believe anyone could perform the work in the glazing rooms with impunity. Other dust-producing processes of course should not be present.

POTTERY.—BISQUE AND GLOST KILNS.

After the "green" ware has been dried and finished in the clay rooms it is next baked in the bisque kilns. From here it may be decorated (under-glazing), but the vast majority of it is glazed in the dipping rooms and then fired again in the glost kilns. Most ware gets the two kilning processes, but stoneware, porcelain ware and unglazed ware is usually subjected to but one kilning. In small places both types of kilns were in the same buildings or sheds and the same workers attended to both. Occasionally a special gang of men emptied the kilns for a certain group of factories.

The bisque kiln process was investigated in 53 establishments, representing all branches of the pottery industry, and the glost kilning in 44 establishments, representing all branches except stoneware and a small amount of unglazed ware, as stated. There was a total of 1,184 males and 36 females (the latter in tile factories) who were employed about the kilns. Of these 658 were bisque kiln workers, 384 glost kiln workers, and the remaining (including females), drawers and helpers. The work was unionized in 32 plants investigated, and a fair to good type of workers was observed in all places. The work is both skilled and semi-skilled. In approximately half of the places the workers remained well at the process. Health appliances consisting of an exhaust or forced ventilation system for the kiln room was observed in 3 places. However, in most places such were not needed because of the spacious character of the kiln sheds and the vents which were left around the kilns. In 4 places cuspidors and refuse cans were observed. Instructions along health lines were given some attention in 3 places. There were no benefit organizations except such as unions maintained. Work quarters were hygienically constructed in 6 places, fairly so in 18 more, and not so in the remaining, due, usually, to low roofs, poor light, crowded spaces and the like, and floors difficult to keep clean, particularly of glaze dust. Sagger washing, sagger placing, and dipping were processes oftentimes carried on in the kiln shed. There were 175 workers over the age of 40, but not more than 10 over the age of 50. There were no youths employed at this process.

Dust was considered a fair to bad hazard to about ⅔ of the workers, and was found to be composed of flint, clay and lead-glaze. Powdered flint was often used to protect the ware in the saggers. The glost kiln workers were the ones who came in contact with the lead-glaze dust, this while they were filling saggers with the ware previous to kilning. No kiln men were required to do finishing or scouring of ware. Quarters were usually brick or cement floored, and were kept well cleaned in ⅓ of the places. In many others cleaning appeared to be very infrequent. *Dampness* was no factor of the process except as workers had to leave the warm kiln sheds. *Daylight* was poor in about half of the places, and in numbers of instances the workers were performing their task apparently as much by feeling as by seeing. The general *ventilation* of quarters was fair to good in half of the places and not so in the remaining

FIG. 72. BISQUE KILN HOUSE.

"Placing" a kiln in the foreground; "drawing" or emptying a kiln in the background. One worker has a "sagger" on his head, filled with dishes to be fired.

half, due to still, dead and overheated air which surrounded the kilns, and occasionally to contamination with coal gas and natural gas. *Heat* constituted a considerable hazard to many workers in half of the places and was found to be also a question of the method employed in drawing the kilns, that is, whether sufficient time was given for them to cool off before entering them. In some places cool air was blown into them, but the hot air forced out rendered the kiln sheds extremely warm. *Cold* was a considerable hazard to about ¼ of the employes, due to the necessity of going to a distance from the hot kiln sheds in the transporting of ware, and to outdoor privies. In no places were shower baths provided. *Fatigue* constituted a hazard to about ⅓ of the workers and was due, chiefly, to hurrying piecework, constant standing (sagger fillers), and somewhat to the laborious character of the work, as in conveying and lifting of heavy saggers filled with ware in and out of the kilns. Usually

these were carried on the head. The work day was found to vary considerably. In only 4 plants was it limited to 8 hours, but in only one did it exceed 10 hours. Overtime was seldom the rule. The noon recess was 1 hour in ¼ of the places, and "as desired" in practically all the balance. A morning recess for lunch was also the rule in nearly all places. A large percentage of the workers usually finished up about three o'clock in the afternoon and went home, although kiln men were usually required to work a little longer than glaze dippers. The liability to the contraction of *communicable diseases* was a bad hazard in 40 places and fairly so in some of the remaining, due, chiefly, to promiscuous spitting, absence of cuspidors, poor or absent washing facilities,

Fig. 73. Glost Kiln House.

Note spacious quarters, high ceiling, good lighting system, clean floors.

poor closets, common drinking cups and the lack of medical supervision. But 3 or 4 of the most modern places had a hospital or emergency surgical room, while first aid equipments were absent or very inadequate in most places. The short-intervaled handling, particularly of small ware, gave fair opportunity for the spread of venereal and infectious diseases among a certain part of the workers. In all glost kiln quarters employing lead in any form there was a risk of lead *poisoning*. This risk was bad in 37 of the 44 glost kiln sheds inspected. It was largely a question of personal hygiene, but was greatly enhanced by the absence or inadequacy of washing facilities. The chief risk came from handling the ware upon which the glaze had just dried, and from which it could be wiped off like flour. On this account it was difficult to keep

it out of the air, and in some instances, particularly in art and colored ware, it was composed of as high as 50% lead. The industrial inducement to *alcoholism* was chiefly in proportion to the amount of dust inhaled, the inadequacy of drinking water facilities, and the liability to lead poisoning.

In but 6 plants were all kiln workers healthy *appearing*. The chief *complaints* of the workmen were the breathing of dust, poor washing facilities, poor closets, and (rarely) heat exposure. The vast majority of glost kiln workers were ignorant of the harmfulness of the glazed ware which they were handling, especially in china ware potteries where it was thought that there was not enough lead present to cause harm. Our investigators found 10 positive cases of lead poisoning, 15 more which were tentative, and 10 who said they had had lead poisoning diagnosed by physicians within the past few months. In addition, numerous hearsay cases were cited. These cases were divided among the different pottery branches as follows: china and white-ware 30, art and colored ware 4, tiles 1.

Comments. — The workers should be given enlightenment by health placards and instructions upon the dangers of lead poisoning. They should be provided with washing facilities, including soap and towels, and with work clothes or aprons which could be easily cleaned of dust. Floors in glost kiln quarters, particularly where the saggers are filled, should be flushed once or twice a day, and benches kept washed clean, as well as carrying boards. Lunches should be eaten elsewhere. In general, everything possible should be done to prevent dust in both types of kiln rooms and to dampen or remove it when it occurs. The physiologic necessity for shower baths for this type of workers has been commented upon in Part III. In many places a useless loss of energy was saved the workers by having the entrances to the kilns at the floor level instead of having to walk up a board 3 or 4 feet or higher to the kiln door entrance. Port-holes or windows in the upper parts of the kilns appeared to give the best kiln shed ventilation when they were below the level of the roof, thus creating a draft or suction within the shed. Where quarters are not spacious, forced ventilation systems should be installed.

POTTERY.—FETTLING AND FINISHING PROCESSES.

The processes here described are not to be confused with the finishing done upon "green" ware in the clay room (*q. v.*), but, after the pottery ware has come out of both bisque and glost kilns, it is rubbed, sanded, dressed, or "fettled", the two latter processes usually being performed with a small steel knife which removes little projections and other imperfections in the ware. The work is largely done in warehouse rooms where the ware is stored temporarily between processes. Females constitute the majority of the workers and they sit about on low stools grouped about baskets.

This process was investigated in 38 establishments representing all branches of the pottery industry. It was found to engage a relatively large number of persons in china, tile and porcelain factories, and relatively few in the art and stoneware factories. It employed slightly more persons on the bisque ware than on the glazed ware. In the plants investigated there were 559 females and 220 males so employed, or a total of 779 wage-earners. Except in some tile and porcelain processes, the work was done entirely by hand. Unions existed in 33 of the plants, although but few of this class of workers belonged

to them. There seemed to be a manifest interest in workers' welfare in 8 plants, fairly so in 26 more, not so in 2 more, while this was not determined in the remaining 2. While the work is of unskilled character, a fair to good class of employes were observed. Their steadiness at the work was a very variable factor.

In one place only were exhaust systems or other mechanical arrangements made for removing the dust from the vicinity of the workers where such should have been present in a considerable majority of all places. In 4 places, room cleaning methods were very good, while cuspidors and garbage cans were provided. But very few of the workers were supplied with stools or chairs having backs. Very few also enjoyed any sick benefit privileges. The general construction of the workroom was hygienically good for the purpose in 6 places, and fair to bad in all the balance. Usually the workers were seated in large warehouse rooms between shelving and stock and in quarters which were *dusty*, only infrequently *cleaned*, poorly *lighted*, insufficiently *heat*ed, and, occa-

FIG. 74. FINISHING OR "DRESSING" WARE IN BISQUE WAREHOUSE.

sionally, even in *damp* basement quarters, or quarters which were very drafty. With but few exceptions, washing facilities were at a premium or absent, as were also lunch rooms, rest rooms, change rooms, lockers, and the like. Closets were usually quite inadequate and poorly constructed, and oftentimes required passing to the outdoors to get to them. In respect to the above described health hazards, 8 places were found to be good, 9 fair, and the remaining 21 bad. Occasionally, the work was done in the vicinity of the kilns or in lofts surrounding the upper part of the kilns where it was unduly hot. *Fatigue* and inactivity were factors in practically all places, due to awkward positions in which the workers sat, to the sedentary character of the work, hurrying piece-work, monotony, stools without backs, as well as incessant noise, as in the dressing of glazed ware. The workday was variable in the majority of places, but usually ranged between 8 and 10 hours. In fact in a large number of places the hours were "as desired", and this applied also to the noon recess. While very few, apparently, worked more than 10 hours a day, a large ma-

jority took less than ½ hour for the noon recess. A good feature was the rule in most places to observe a morning recess of about 10 to 15 minutes for a lunch which was eaten in the workrooms in nearly all places. While the large majority of workers were girls and young females, there was a scattering of older women, even up into the sixties. The liability to the contraction of *communicable diseases* constituted a fair to bad hazard in 35 places, due chiefly to close crowding together of the workers (often with their heads nearly touching as they bent over the large basket before them), common drinking cups, poor or absent washing facilities, promiscuous spitting about the dusty floors, improper toilets, and the absence of medical supervision. *Poisoning* was not a hazard of the process as a rule, because, even, with those working on glazed ware the latter had been previously kilned. However, some workers were found to be doing work which brought them in contact with lead. The industrial inducement to *stimulantism* was considerable and was in proportion

FIG. 75. FINISHING OR "DRESSING" GLOST WARE, AFTER SAME HAS BEEN DRAWN FROM GLOST KILNS.

to the amount of dust breathed from the process, the factors of fatigue and inactivity above stated, as well as the depressing influences of insanitary workrooms, where such existed.

While a goodly number of employes appeared *hale* and *hearty*, this could not be said of the majority. The chief *complaint* of the workers was the breathing of the dust created in the sanding, rubbing, or "fettling" of the ware, getting particles into the eyes, and the lack of proper sanitary conveniences. Scouring with bristle wheels (occasionally observed), the grinding processes in tile works and fettling in porcelain shops were the dustiest processes observed, and in no place was there a blower system to provide for this. Too much dependence was put upon the heavy character of the dust to keep it out of the breathing atmosphere. Other than the effects of dust, 3 cases of lead poisoning were seen among workers who were engaged on glazed ware. *Comments.*—It appears to be the custom abroad to do this class of work over flat trays of water on benches at the backs of which are ex-

haust hoods which draw the dust away from the faces of the operators. The work should be done also in as moist a condition as possible. A good feature in some plants was the interruption of the sedentary character of the work by requiring the employes to secure their own supplies of materials and convey the same away when finished. Finishing of plates and similar china-ware can be done in sieves with broken ware, the whole placed in a tumbler and revolved. Hand brushing can be done inside of cabinets or hoods, or over slatted table tops with down draft suctions.

POTTERY.—DECORATING.

Decorating in potteries may be done before or after the glaze is applied, while the glaze itself may be colored. The vast majority of the decorating is done after the ware has been glazed and baked. The chief processes consist in laying on decalcomania transfers, by "sizing" with turpentine, stamping on impressions, "lining" with gold stripes and gilding, while in artware and stoneware, color spraying (tinting) and hand-painting, or paint-dipping is frequently

FIG. 76. DECORATING DEPARTMENT.
A row of gilders applying coin gold to the ware.

done. There is also some direct printing on of colors, and very infrequently "ground laying", by which the colors are dusted on. (Mottled coloring in tile works has been considered under "glazing".)

The decorating process was investigated in 40 establishments and engaged 1,101 employes, of whom 404 were males and 689 were females. In some of the plants a few of the workers were ignorant foreigners unable to speak English. With this exception all were of an intelligent class, while many were skilled and old-time employes. The unskilled, who constituted the majority, for numerous reasons, did not work very steadily. Health appliances consisting of exhaust hoods to draw off the sprays were present in all places where tinting was done, although their efficiency was questionable in a number of instances. In 1 establishment where considerable "ground laying" was done, an arrangement was at hand which completely confined the dust. Air-conditioning mechanisms for general room ventilation were efficient in 4 places, fair in 3, and absent in the remaining 33. Instructions along health lines were well given in three places only. This extended to care of fingernails, allowing time for

washing up, and all sanitary conveniences. Health placards were not observed. Organized sick benefit privileges were features for the members of unions only. Workrooms were hygienically constructed in 15 places, but not so in the remaining 25. Other processes such as dipping, clay-room work and storage were also present in 7 plants. In some places the different sub-processes were done in small rooms by themselves, but usually all processes were carried on in one or two large rooms. The age-group estimations summed up as follows:

Age Groups.	*Number of Wage-earners.*
Over 50 years	10
Between 45 to 50	27
Between 40 to 45	54
Between 20 to 40	895
Under 20	115

A great many females and quite young girls were employed.

FIG. 77. DECORATING DEPARTMENT.
Decalcomania machines in the background.

Work quarters were kept free from *dust* in 12 places, fairly so in 23 others, and not so in the remaining 16. Outside of tinting, however, (and the rare "ground-laying" mentioned), the dust came from other causes than the processes themselves. *Cleanliness* of quarters obtained in about the same proportion of places. In 6 places quarters were *damp* enough to constitute a bad hazard, and in 10 others there was some question as to this. *Light* was good for all workers in 22 places, but for some it was only fair in 13 places, and bad in the remaining 5. In some places workers were found busily engaged at close eye work under naked electric lamps. The *air* of workrooms was very good in 5 places, because of exhaust systems, spacious quarters, or the absence of features to contaminate it; it was fair in 22 more, and bad in the remaining 13. Especially were turpentine fumes noted. *Heat* was no factor in 29 places, fairly so in 5 more, but was bad in 6 places, due to proximity of drying ovens and kilns. *Cold,* due to inefficient heating, was apparently a just complaint in 7 places. *Fatigue* was some factor in 23 places, due, principally, to hurrying piece-work, constant application at the same manipulations

and less often to constant standing still, (in some instances, girls, 9 hours per day on a concrete floor), chairs without backs and long hours. Artists and designers had the same risks as described elsewhere. The workday was found to be 8 hours in 4 places, up to 9 hours in 6 places, and between 9 and 10 hours in the remaining 28. The noon recess was 1 hour in 10 places, ¾ hours in 1 place, ½ hour in 10 places, and "as desired" in the remaining 19. The usual morning lunch recess was allowed in most places at about 9 a. m. The liability to contracting *communicable diseases* was a fair to bad hazard in 33 places, due to various factors such as the common use of drinking cups and towels, inadequate washing facilities, poor closets, spitting on the floors, the absence of cuspidors, separate lockers in which to

FIG. 78. POTTERY TINTING OR AEROGRAPHING.

This was one of the most efficient systems seen. Workers well separated. Powerful exhaust catches all the fine spray. Note also seats with back rests.

hang clothing, and the absence of medical supervision. The tinters were the most exposed to *poisoning*, this from the lead contained in the fine sprays which they used. Since cobalt is obtained from arsenical ores there is danger of arsenic poisoning in cobalt spraying. While tinting was always done in a hood the front opening of this ranged from 4 to 10 feet square and permitted of escape of a certain amount of spray. This could be seen by stains on the surroundings, the workers' clothing and, even, faces, in some instances. It was favored also by having a row of such workers placed close together. In 13 plants, which includes most of those in the State where tinting, or color spraying is done, there was found to be a total of 42 persons so engaged, 30 males, and 12 females. Intelligent, skilled workers did tinting in some places; ignorant foreigners (girls as a rule) in others. A much larger

number of decorators (usually girls) were exposed to turpentine vapors from sizing. The industrial inducement to *stimulantism* was a hazard to about half the employes, due to subjection to one or more of the hazards given.

In general, decorators were fairly *healthy looking*, but a goodly number were anemic and under par. Our investigators saw among them 2 positive cases of lead poisoning, 1 other case which was tentative, 1 "ground layer" who had lead, and perhaps arsenic, poisoning, and 1 person who was suffering from benzine varnish poisoning. The chief *complaints* of the workers were the effect of turpentine fumes (eyes, skin, appetite and kidney trouble), feeling weak and tired, loss of appetite after being in the work for a while, and skin eruptions and sore eyes from the sprays, solutions and fumes with which they came in contact. *Comments.*—Gold stampers, liners and gilders appeared to be free of any poison risk, while the balance needed protection, which in most places was not adequate. Varnishing tables should be sup-

FIG. 79. DECORATING KILN ROOM.

Here the decorated ware is fired. (Exactly similar to "china firing").

plied with a hood and exhaust, within the opening of which to do the work. Tinters should wear gloves; the openings of the tinting hoods or cabinets should be much narrowed by curtains or wings, while, in the case of large work, respirators, caps, and covering for the clothing should be worn. The best tinting arrangement seen was in a tile works where the spraying was done under a long hood having a powerful exhaust, while at the rear was a "water wall," the wet surface of which caught the escaping spray and carried it down to a drain in the cement floor. Every case of sickness among decorators should be investigated by a shop physician. Adequate sanitary conveniences, health placards and instructions are the remaining important suggestions.

POTTERY.—SHADING AND TILE SORTING.

This process was investigated in 4 establishments and consisted in the matching of different shades of glazed tiling and sometimes other ware. This

was done by comparing the ware (largely white tiles) with standard shades. There were a total of 96 employes so engaged, of whom 76 were females. *Fatigue* seemed to be the chief hazard and due principally to the eye-strain involved in the work which necessitated the eyes being directed downward for hours at a time upon the glaring white tiles and glazed surfaces. Piece-work prevailed. Monotony was also a factor, while in 1 place there were no backs to the stools on which the workers sat. The workday was 9 hours in 1 place, and 9½ to 10 hours in the remaining, the noon recess being ½ hour, while a morning recess was customary. The risk of lead *poisoning* from sorting the glazed ware (now baked) seemed negligible. Some of the workers were furnished with finger-cots to prevent roughening of the skin. While careful attention was given to window shades and *lighting*, many of the

FIG. 80. SHADING AND SORTING OF ART, FLOOR AND WALL TILES.
The girls match the various shades of white (and colored) tiles to get uniformity.

workers sat directly facing the windows. *Complaints.*—Some of the workers said they were bothered with headaches at first, but soon got used to the work. *Comments.*—The wearing of eyeshades, ocular corrections where necessary, light from the side instead of the front, chairs with backs, and the interruption of sedentary work by requiring the workers to get their own supplies are the chief suggestions.

POTTERY.—TILE MOUNTING.

In order to give mosaic effects, the small tiles are sorted out according to colors and shapes, usually by females, and applied to a gummed paper surface, a flour water paste being used. Although stools were provided.

Fig. 81. Art, Floor and Wall Tiles.
The ceramic mosaic tiles are arranged by girls and pasted on sheets of paper, each containing about two square feet of tiles.

most of the workers stood. They worked piece-work, sometimes in light which was not good and in 1 or 2 places exposed to heat from other processes. They usually wore finger-cots to prevent the wear and tear upon the fingers. Careless handling and dumping of boxes of tiles created some dust.

POTTERY.—PACKING AND SHIPPING.

Packing pottery ware for shipping purposes employes a considerable number of workers, usually men. This process was found to be a very dusty

Fig. 82. Packing.
Here the ware is packed in hay or straw for shipping.

one, due to the dust and dirt coming out of the bales of low-grade straw used for packing purposes. The work was done many times in dark, poorly ventilated quarters, sometimes in damp basements, or in open freight cars, and usually as a piece-work process. Persons with any tendency toward consumption should not be employed at this process. In one instance a young man was seen who had returned to work packing pottery in freight cars after a long illness from consumption which had been checked by careful treatment in a sanitorium. Return to this work will unquestionably restult in a return of his disease.

GLASS.—INGREDIENT MIXING.

This process consists in combining the various silicous materials, alkalis, and other ingredients used in the manufacture of the matrix for glass. The different materials are contained in bins and hoppers, and are mixed in certain proportions after weighing or measuring. The work is done usually in part by machinery and in part by hand labor, the latter causing a great deal of dust because of shoveling and scooping.

This process was investigated in 16 establishments ,employing a total of 94 wage-earners, all males. Hence it will be seen that there are but a few men so employed in any establishment. Methods were modern in 10 places, fairly so in 3 others, and antiquated in 3. The work was largely done by foreign laborers, non-English speaking, in 11 places. In 5 smaller places all workers were English-speaking. They appeared to remain steadily at the work in 8 places, fairly so in 3 others, and not so in the remaining 5. Mechanical appliances, hooded automatic mixers to confine and remove the dust were absent in 12 places, practically so in 2, and of good efficiency in the remaining 2 places. The work is unskilled. But 8 men were over 40 years of age. The workplaces were considered as hygienically constructed in 7 places, fairly so in 4 others, and bad in the remaining 5. The work was invariably done in a part of the plant by itself, and not in quarters with other processes.

Dust in the air was noted in all places. In 1 it was negligible, in 3 fairly so, and in 12 places it was bad, due to the manner of handling the ingredients. In small places workmen were only so employed at intervals, but in large places there were several practically continuously engaged. *Accumulations* of dust and dirt were negligible in 3 places, fairly so in 2 others, and bad in the remaining 11. *Dampness* is no feature of the process itself, but in 1 place the work was done in a very damp cellar. *Light* was good in 13 places, fair in 1, and bad in 2 places, due to poor locations. Room *ventilation* was generally bad in 8 places, fairly so in 5, and good in 3, the former due both to contamination of the air with dusts and to the confinement of the quarters. *Heat* was no factor in 12 places. It was fairly warm in 1 place and hot in 2 places, due to proximity to other processes. *Cold* and drafts were no features in 10 places, were a fair hazard in 3, and more so in the remaining 3, due to weather exposure, and absence of heating methods. *Fatigue* was hardly a feature except for long hours, as noted in 1 place. The workday was 9 to 10 hours in 15 places and 12 hours in the remaining. The noon recess was ½ hour in 5 places, 1 hour in 10 places, and none in 1 place (the same place which required a 12 hour day and 7 days a week, with alternations between night shift and day shift once every week.) Other

recesses were frequent enough for rest intervals in all places. The contraction of *communicable diseases* was a bad hazard in 13 places and fairly so in the remaining 3, due, principally, to dust, dirt, improper wash-places and closets, spitting into the dusts, absence of cuspidors, lack of physical examinations and medical supervision, and use of common cups. *Poisons* were a negligible hazard in 2 places, fairly so in 3 others, but a considerable hazard to some employes in the remaining 11. These poisons were found to consist of litharge, red lead, soda ash, arsenic, manganese dioxide and occasionally antimony, all in the form of dust. The hazards were, chiefly, ignorance of the workers, lack of instructions, disregard of instructions,

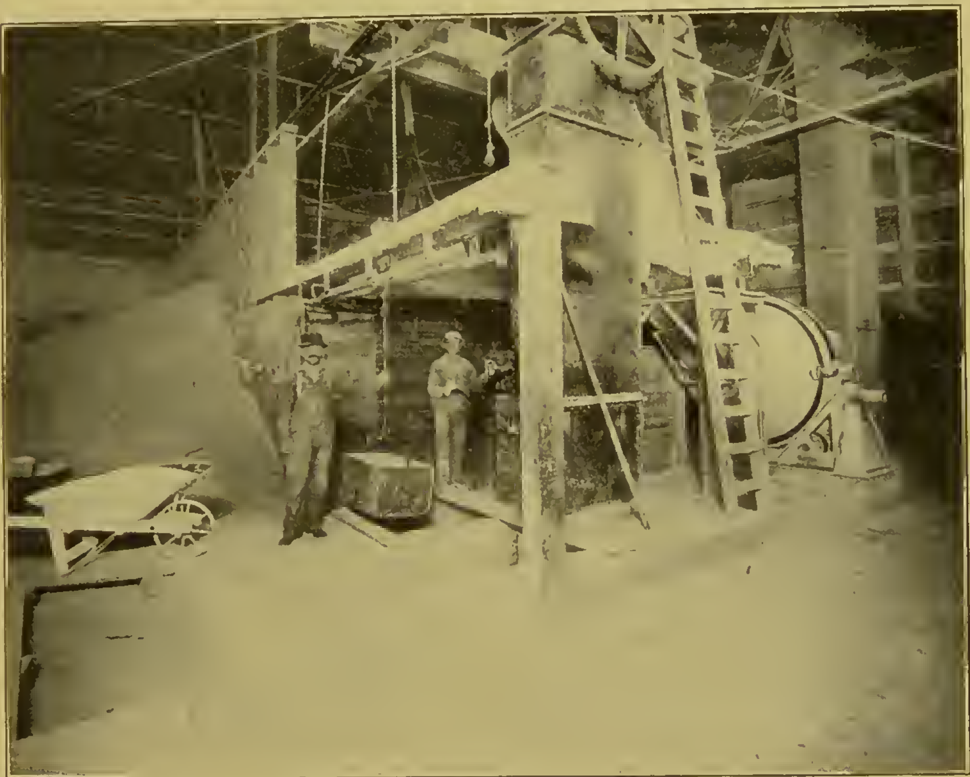

Fig. 83. Batch House in Glass Factory.
Glass ingredient mixing.

wearing of mustaches, eating and chewing in work-rooms, lack of medical supervision and respirators, proper washing facilities and closets, and of mechanical protection from poisonous dusts. The poisonous ingredients are only a small part of the material, and in some places are not used, while again red lead and arsenic trioxide are consumed quite extensively, — one plant claiming they used two tons of the arsenic per month. Usually an intelligent worker or the foreman handled the arsenic, but lead and the other poisons were mixed by ignorant workers, usually foreigners. The inducement to *industrial alcoholism* was present in 6 places, and fairly so in 5 more, due to inadequate drinking water facilities, and the depressing influences of the hazards above stated.

The *appearance* of the workers was good in 4 places, in 8 there were 1 or more who appeared only fairly healthy, while in the remaining 4 places several were certainly in need of a physical examination. Many workers were wearing handkerchiefs over the nose and mouth for protection against the dust. The workmen's chief *complaints* were breathing of the dust, coughing, frequent nose-bleed (from soda-ash, especially), sore feet (due principally to the same cause), and, in 1 place, the long hours. Our investigators found among the workers 5 positive cases of plumbism, 1 tentative case of plumbism, 1 case of dermatitis, and 1 case of perforated nasal septum (an effect of breathing alkali dusts); in addition, 2 other cases of the last complaint were reported, but not seen by our representatives. *Comments.* — This work should be done in light, ventilated, dry quarters, above ground preferably, and, where mechanical means will not confine dust, workers should be furnished respirators of some sort, and compelled to wear them. Particularly should cuspidors be plentiful, and those handling or exposed to poisonous dusts should be selected for intelligence, properly instructed, and seen by a physician at least once a month. The hazards above noted suggest other corrective measures.

GLASS. — BLOWING BY HAND.

In this process the end of the blowpipe is passed through a circular opening in the wall of the glass furnace, and a sufficient quantity of molten glass collected upon its end. The pipe is then withdrawn, placed to the lips and the blowing started. It is then usually handed to another man, the skilled glass-blower, who, while turning it, continues the blowing, either in the air or with the ball of glass in a mold. Occasionally, a third blower is necessary, especially on large objects. The glass object is next freed from the blowpipe, usually by a boy who sits below and in front of the glass-blowers. After some trimming while still hot, the glass object is carried to an annealing furnace (or leer) nearby, usually by boys. After a proper time the objects are removed from the annealing furnace by hand or mechanically.

This process is here reported upon in 19 places, and employed a total of 3,369 wage-earners, all males. Of these, 757, or 28.6% were boys under 20. In 4 of the 19 places no youths were employed at all, while in 1 place there were 46 youths out of the 100 employed at glass blowing. The attitude toward workers seemed good in 14 places, fairly so in 4 others and not so in the 1 remaining. All workers were of an intelligent type in 8 places, all fairly so in 8 more, while in the remaining 3 the workers were largely ignorant foreigners. The workers appeared to remain well at the process in 12 places, fairly so in 5 others, and to be of short stay in the 2 remaining. Health appliances (described below) were of fair efficiency in 12 places, inefficient in 5 others and absent in the 2 remaining. In all places skilled glass-blowers were employed, but of the total employes less than 1/10 could be considered skilled. Of the total employes, 263 were over 40 years of age, but very few over 50; 2,349 were between 20 and 40, and 757 were under 20 years of age. The workplace was hygienically constructed in 11 places, fairly so in 3 others and bad in the remaining 5. Other processes than glass blowing or pressing, as a rule, were not done in the glass blowing quarters, although in 3 places finishing processes were present.

The process in itself is not *dusty*. However, *accumulations* of broken glass, largely pulverized into a fairly fine dust, were allowed to collect

on the floors to an obnoxious extent in 6 places, fairly so in 4 others, while in the remaining 9 the floors were kept sanitary. *Dampness* is no feature of the process. *Light,* both natural and artificial, was good in 15 places, while in the 4 remaining it was fair to bad. The glow from the furnace openings and the molten glass was largely depended upon for light in many places. On this account shadows and dark places promoted the likelihood of accidents. General room *ventilation* was good in 12 places and fair to bad in the remaining 7, due to crowded quarters, escape of gases and faulty construction for ventilation. Exposure of the workers to high *temperature* was pronounced in 13 places, fairly so in 4 others, and practically negligible in the remaining

FIG. 84. GLASS FURNACE ROOM.
Hand blowing and machine pressing of glassware.

2. In all the hot places much protection could have been accorded by a greater use of heat protecting appliances (see below). In some places visited the heat to which both men and boys were exposed was excessive. *Cold* drafts of air, going from hot to cool places, inefficient heating in the outskirts of the room, sedentary work, with drafts upon the back, especially in winter, were a bad health-hazard in 11 places, fair in 6 others and negligible in the remaining 2. The work is not unduly *fatiguing* to normal adults, especially after a little experience, but many youths were found to be doing exhausting labor. This feature was rendered much worse by the heat. The hours of labor varied greatly in different places. In one place there were 4 shifts of 6 hours each; in 3 places 3 shifts of 8 hours; in 12 places the work period

ranged from 8½ to 9 hours; in 2 places from 9½ to 10 hours; in 4 places the total workday was 12 hours, but in 3 of these there was a middle interval of 4 hours off. In places with the longer workday, brief respites from work at intervals were the rule. The "noon" recess was ½ hour in 4 places, from 1 to 1½ hours in 11 places, and, as mentioned, 4 hours in 3 places. In one place there was no noon recess, and the workers had to remain within the plant for a day of 12 hours, with, however, numerous rest intervals. This was the plan for 7 days per week. Shifts usually changed once a week—too frequent for workers to get used to it, thereby resulting in loss of sleep. Other fatigue factors were piece-work, speeding up, monotony, constant standing for some, faulty postures (of sedentary workers), and lifting and straining, especially for youths. While all helpers, including the boys, were paid on a day work plan, they were required to keep up with the skilled glass-blowers who worked piece-work in nearly all places. Although boys under 18 are prevented by law from working after 10 o'clock at night, the irregular shifts, irregular eating and sleeping periods, quitting and going to work at almost all hours of the day and night, and, in some places, sleeping around the plant, are decidedly unphysiological factors for even adult human beings. To sum up, fatigue hazards were considered bad in 14 places and fair to negligible in the remaining 5. The liability to contracting *communicable diseases* was considered bad in 13 places, and fair to negligible in the remaining 6, due to such hazards as crowding of workers, promiscuous spitting onto dusty floors, absence of cuspidors, inadequate or absent wash-places, improper closets, common drinking cups, the successive mouthing of blowpipes by 2 and sometimes 3 persons, the lack of goggles, frequency of trivial injuries, the lack of health certificates for youths and of physical examinations for adults. *Poisoning* is hardly a factor in this process. The inducement to industrial *alcoholism* was bad in 5 places, fairly so in 12 others and negligible in the remaining 2, due to inadequate drinking water facilities, combined with the depressing influences above described.

In but 3 places were the workers all *healthy looking,* in 12 others a few appeared in need of a health examination, while in 4 a number of workers were decidedly unhealthy looking. The workers' *complaints* were chiefly the heat, irregularity of work, and in some cases long hours, cold drafts, insanitary closets, closets reached only by passing through cold areaways, poor washing facilities, frequency of colds, catarrh, "grippe," sore throat, hoarseness, bronchitis, asthma, rheumatism, tuberculosis and pneumonia, difficulty in getting life insurance, and the short span of years at the trade. The innocent spread of *venereal diseases,* particularly syphilis, through the common mouthing of the blowpipe was illustrated in one place where a physician cited a chancre of the lip which had been followed by other cases of syphilis. Heat prostration was another occupational disease common in this process. Great dilatation of the cheeks was occasionally noted in older glass-blowers, sometimes accompanied by salivary disturbances. Cataract, due to heat and glare, was not a complaint of the workers whom we consulted at the plants, but, as this condition usually appears sometime after quitting the work (from 50 years of age upward), we are not warranted in disclaiming its existence. Physicians in glass works' vicinities, however, called our attention to its existence among their glass-working patients. *Comments.*—As may be seen from the above, there are some plants doing glass blowing in which health-hazards are nearly negligible

features. These have resorted to many expediencies to bring this about, as, for instance, air blasts to play upon workers in hot locations, electric fans to stir up the air and cause evaporation of sweat, movable heat shields, movable draft shields, steam heat for winter, goggles to protect against the heat, colored glasses where the light is intense, leather boots, asbestos body coverings, asbestos over leer-doors and screens, frequent cleaning, good toilets and washing facilities. There are also needed cuspidors, the abolishing of promiscuous spitting, shower baths for all hot process workers, room thermometers, careful medical supervision, especially to keep out tuberculous persons and those suffering from venereal diseases and sickly-inclined persons. The most satisfactory work shift would appear to be that which permits of an 8-hour work day, spread over 12 hours, as follows: 2 P. M. to 6 P. M. and 6 P. M. to 10 P. M., or 6 P. M. to 10 P. M. and 10 A. M. to 2 P. M., thus avoiding night work entirely. This was claimed to be very satisfactory in 2 large plants which manufactured chimneys, globes and glassware. It may not be feasible for all places, in which case the 8-hour shift system, with changes not less than bi-monthly is recommended.

GLASS. — BLOWING BY MACHINERY.

Glass blowing by machinery, so far as we investigated, was found to be limited to the manufacture of glass bottles, which were blown or molded by machinery using air pressure.

The process was investigated in 4 plants, in which 625 wage-earners were so engaged, of which 42 were youths under 20 years of age. The attitude towards employes seemed good in all places. The workers were largely of intelligent type in 1 place, fairly so in 2 others, and non-English speaking foreigners in the remaining 1. Retention seemed good in 1 place and bad in the remaining 3. Health appliances were fair in 3 places and practically absent in the fourth place, where a large number were employed. The workers were largely unskilled. Of the total workers, about 400 were between 20 and 40 years of age, about 80 between 40 and 55, and the balance youths. The workplace was hygienically constructed in 2 plants and not so in the other 2. In 2 plants hand blowing was done in the same quarters.

Dust was a negligible factor, but pulverized glass and waste *accumulations* upon the floors were bad in 2 places. *Dampness* was no factor. Two places were well *lighted* and in 2 the quarters were only fairly so. General room *ventilation* was good in 3 places and only fair in the other, due to the presence of escaping fumes and to crowded conditions. A number of the workers in all places were exposed to dangerously high temperature. One place had a part of its work, however, so provided for that *heat* was only a fair hazard. *Cold* drafts, absence of heating systems and toilets which were practically outdoors, and exposed, were bad features in 1 place and fairly so in 1 other. The influence of fatigue was bad in 2 places, and a fair hazard in the 2 remaining, due to hurrying piece-work, speeding up, monotony, constant standing by many and constrained postures. The workday was 8 hours in 1 place, 9 in another, and 12 hours in the 2 remaining. The noon recess was 1 hour in 2 places, ½ hour in 1 place, and not allowed in the last, where, however, frequent rest intervals during the 12-hour day existed. The liability to contracting *communicable diseases* was bad in 3 places and fairly so in the other.

due to such factors as promiscuous spitting, absence of cuspidors, improper wash places and closets, crowding of workers together, the frequency of trivial injuries and lack of medical supervision, and health certificates, particularly in the case of youths. *Poisoning* appeared no hazard. The inducement to industrial *alcoholism* was bad in 1 place, fair in 2 others, and quite negligible in the remaining 1, due to inadequate drinking water facilities and the depressing influences of the hazards above mentioned.

Some *unhealthy looking* workers were observed in all places. The chief *complaints* were heat, drafts, and in 2 places long hours. Heat prostrations were reported, and in 1 plant a case of sudden death while at work, presumably due to heat exhaustion. *Comments.* — See glass blowing by hand.

GLASS. — PRESSING AND ROLLING.

In the case of pressing, as in the making of table glassware, the glass is removed from the furnace by means of a rod, placed in a machine mold and pressed into the desired shape mechanically. In 1 place glass was rolled into thin sheets with a hand-operated roller, the process being fairly free of health-hazards.

The process was investigated in 7 plants, and was practically identical in all. It was done in the same quarters with hand blowing in all but one place. Health appliances and construction of building were practically the same as in hand blowing.

All hazards were less than in the other hot processes, although here and there *dirty* quarters, poor *light*, inefficient heating systems, exposure to undue *heat* and to *drafts*, and possibility of contracting *communicable diseases* were noted. *Fatigue* was not apparently a hazard of moment, except in the case of youths.

The general *appearance* of workers was good in 3 places, while a number were in need of a health examination in the remaining 4. *Complaints* by workmen upon the nature of the work were infrequent. *Comments.* — See glass blowing by hand, although certain modifications are permissible for this less hazardous process.

GLASS. — FINISHING.

Under this head are included a variety of processes usually performed after the glass has come from the blowing room and annealing ovens. The various procedures include grinding (wet or dry), sanding, polishing, buffing, filing, drilling, beveling, cutting, and occasionally some hot cutting and heating for purposes of smoothing the edges.

These finishing processes were investigated in 23 establishments in all lines of the glass industry, and found to engage a total of 858 wage-earners, of whom 572 were males and 286 females. In 2 places very crude methods were used, in 4 places not much better, while in the remaining 17, methods were apparently modern. In 6 places unions existed. Attitude towards workers appeared good in 18 places, fair in 2, and poor in 3. The mass of workers were of an intelligent type in 19 places, fairly so in 3, and not so in 1 large place. Retention was good in 18 places, fairly so in 3, and not so in 2, including 1 large place. Health appliances, especially those consisting of hoods to remove dry dusts from grinding processes, were good in 2 of the 8 places where such was done. In none of these 23 places did sick or death benefit

organizations exist for this class of workers. The workers were very largely unskilled labor. There was a total of 45 persons over 40 years of age, 727 between 20 and 40, and 86 under 20, of which last number the majority were girls. Work room construction was hygienically good in 13 places, fair in 1 and bad in 9. Other processes than those mentioned were done in some places, such as electro-plating, packing, painting, soldering, etc.

Dust was no factor in 16 places, was a fair hazard in 4 places and bad in the remaining 3, due to dry grinding and finishing without local exhaust systems and to powders used for polishing. Quarters were *clean* in 7 places,

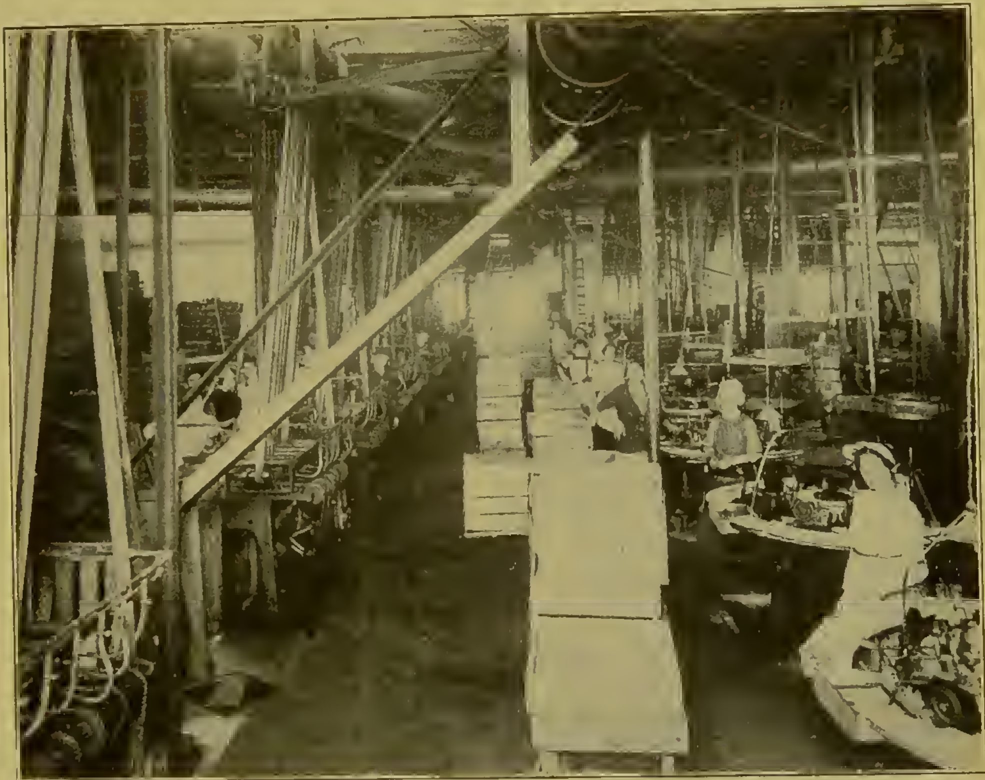

Fig. 85. Glass Grinding Room.

Revolving machines (on right) are grinding down uneven edges on glass tumblers which the girls manipulate.

fairly so in 13 and not so in 3. *Dampness,* due, principally, to carelessness in wet grinding, was a bad hazard in 3 places, fairly so in 12 others and no factor in the remaining 8. Quarters were well lighted in all except 3 places. General room ventilation was bad in 1 place, fair in 7 and good in the remaining 15. *Heat* was no factor in 19 places, was a fair hazard in 3 and bad in 1. *Cold* and drafts, due to inefficient heat for the winter season, were features in a number of places. *Fatigue* was a negligible factor in 10 places, fairly so in 6 places, but considerable in the remaining 7, due to hurrying piece-work, monotony, constant standing, speeding up, stools without backs, faulty postures, and in some cases eye-strain. The work day was 8½ to 9 hours in 14 places, 9 to 10 hours in 8 places and 12 hours in the remaining 1. The noon recess

was 1 hour in 10 places, ½ hour in 12 and absent in 1 (where, however, rest intervals were frequent). The possibility of contracting *communicable diseases* was negligible in 2 places, fairly so in 12 others and great in the remaining 9, due to promiscuous spitting, absence of cuspidors, inadequate washing facilities and poor toilets, common cups, frequent trivial injuries, common handling of objects, and the absence of medical supervision. *Poisons* were no hazard in 17 places, fairly so in 1 place and apparently bad in 5, due to the use of powders containing lead in polishing, and acids such as HF, H_2SO_4 and HCl, used for cleaning, etching and soldering. The inducement to industrial *stimulantism* was present in 20 places, due to various factors in different places,

FIG. 86. GLASS FACTORY — FINISHING AND SELECTING.
In rear are melting machines used to melt and smooth edges on glassware. Girls in foreground are doing the final sorting and selecting.

such as inadequate drinking water facilities, and the subjection to the depressing influences above mentioned.

While in this large number of workers a few of unhealthy *appearance* were found in most places, still this was especially so in 6. The general *complaints* of the workers were breathing of acid fumes and dust (where not confined), many, especially girls, complained of cold damp rooms in winter time, and in 1 place the foreman admitted great danger of lead poisoning, 1 case of which our investigators found at work, as well as a case of rhinitis and conjunctivitis from acid fumes.

Comments. — The hazards mentioned above suggest the remedies needed. Fortunately a very few persons were found to be handling poisons.

GLASS. — ETCHING.

This process usually consists in the use of HFl acid by methods well known, and was investigated in 4 places employing a total of 10 workers, of whom 9 were males and 1 female. It was usually done in a place by itself, and, outside of general conditions which were the same as those described under glass finishing processes, the chief hazard was the use of the acid in question, which was generally mixed, also, with other inorganic and even organic acids such as acetic and carbolic. In 2 places the workers *complained* of fumes, of headache, nausea, coughing, and, in one place, of burns, due to the use of the acid. Excruciating pain was the complaint in 1 case seen, in which the acid had caused no more than a little redness and superficial laceration on the fingers. As well known, this characterizes hydroflouric acid burns. Special rubber gloves should be provided for such workers, and exhaust systems locally applied to remove fumes. This was well carried out in 2 places. Sand-blasting has supplanted much acid etching.

The etching effect is also produced upon glassware by a totally different process from that described above, in which the design is stamped on the glass with a paste, and zinc oxide is then dusted on. This is usually not done under a hood, resulting in some complaints of coughing. The glass is then heated and the finished product looks as though it were etched. There are no other health-hazards connected with the process as far as could be determined.

ART GLASS PROCESSES.

Aside from the glass processes designated previously, there are some features such as painting, decorating and spraying of glass, assembling it into metal frames, lacquering, shellacing, varnishing, etc., which employ a fairly large number of workers, mostly females, in which the chief hazards are the fumes of turpentine, amyl acetate, wood alcohol and benzine, also a risk of lead poisoning (principally in the soldering together and handling of lead composition frames). The chief *complaints* of workers in 2 establishments employing a total of 90 workers so engaged (75 of whom were females) were dizziness, headache, coughing, nausea and indigestion.

Comments. — Greater confinement or local removal of fumes and vapors, the use of finger cots and gloves, exhaust hoods over spraying apparatus, and, especially, medical supervision of the workers are essential.

STONE SURFACING.

This process, which includes chipping, rough surfacing, lettering, designing, scouring and polishing of marble and stone surfaces, was investigated in a total of 17 plants, in 6 cities, employing 298 wage-earners, all males. Marble and monument works, as well as the small amount of stone surfacing in connection with quarries, are included.

Unions were found to exist in 5 of the plants seen. The general attitude of employers toward the welfare of the help seemed very good in 14 places, but more or less indifferent in the 3 remaining, where some 35 persons were employed. A skilled and intelligent type of help was largely employed in 8 places, fairly so in 8 more, and not so in 1 plant employing 25. Retention at work appeared to be good in 15 places, but not so in the remaining 2. In 3 places health appliances, consisting of exhaust systems locally applied for dust,

and heating arrangements were found good, in the remaining 14 places they were absent, or very inefficient. In no places were any attempts made to instruct workers in matters of health conservation, nor were there sick benefit organizations at any establishment. The general construction of work quarters was considered hygienically good in 4 places, fairly so in 5 more, and not so in the remaining 8. Many of them were simply sheds. Other processes were not carried on in the same quarters as a constant procedure. The age-group estimations summed up as follows: over 50 years years, 6; 45 to 50 years, 27; 40 to 45 years, 52; 20 to 40 years, 209; and under 20 years, 4.

Stone and marble *dust* contaminated the breathing atmosphere enough to be a bad hazard in 15 places and fairly so in the remaining 2. The air blast from compressed air cutters blew the dust away from workers to a large extent, but as most of them worked with faces within 4 to 6 inches of tool, they breathed lots of dust. Only a few wore respirators. Where wet methods were used (which was rare) the drying up of the drippings under foot, which were allowed to accumulate, was also a source of dust. In most places the ground was the floor. In some of these steam pipes were buried in the earth for winter heat. Quarters were kept fairly *clean* and orderly in 5 places, but little attention was given to this in the remaining 12. *Dampness* from polishing and planing processes (usually machine work) done in the wet, was a bad hazard in 5 places and fairly so in 2 more. Work quarters should have been better *lighted* in 8 places. In many places no artificial light was at hand, which was particularly bad for designers on dark days. In 12 places workers in the *cold* season of the year had very little protection from chill. In this respect, however, the work fell off considerably in the winter season. Many places depended upon coke stoves for *heating*. *Fatigue* was some hazard in all places, and particularly so in 5, due to monotonous application at piece-work, with constant standing in awkward positions, while laborious work, jarring processes (pneumatic tools), constant pressure against the person and loud noises were other features. The workday was found to be 8 hours in 8 places, 8+ to 9 hours in 3 places, and 9+ to 10 hours in the remaining 6. The noon recess was 1 hour in 9 places, ¾ hour in 3 places, and ½ hour in the remaining 5. The liability to contracting *communicable diseases* was a hazard in all places, and particularly so in 12, due to the constant presence of dust as a medium of carrying infection, as well as promiscuous spitting into the dust and dirt, the absence of cuspidors, the absence or great inefficiency of washing facilities and closets, common drinking cups, frequent trivial injuries, flying particles, and the absence of any medical supervision. First-aid equipment, gloves, goggles, thumb "jibs," finger cots, etc., were usually lacking, or little used. The workers were also subject to callouses which became easily infected with consequent danger of blood poisoning. The hazard of *poisoning* was rare, although scouring with wet pumice, oxalic acid, tin oxide (perhaps containing lead) was found to be in vogue in some places. There was danger of the paste drying up and being inhaled; also of affecting the skin. In 1 place the fumes from a gas engine fouled the atmosphere. The industrial inducement to *alcoholism* was in direct proportion to the irritating effects of dust, fatigue, dampness and cold surroundings.

The general *appearance* of workers averaged good in about half of the places. The chief *complaints* were the breathing of dust (worse in winter), catarrh, colds, sore hands, fissures in the crevices of fingers, the irritating

effects of oxalic acid on the throat and skin, and damp work quarters. Our investigators reported numerous cases of eye injuries, conjunctivitis, bronchitis, sore throat, dermatitis, and some tuberculosis cases. *Comments.* — The following is taken from the Bulletin of the Ohio State Board of Health, January, 1914, p. 99:

> "A man doing ordinary work breathes 21 cubic feet of air per hour. If this air is saturated with dust, gases or poisons, he also breathes them. In our modern methods of *drilling rock, slate-mining, quarring* and *stone-cutting*, men breathe no end of pernicious dust. The English found that rock drillers, who have no protection, average eight to ten years at the trade, and their average age at death is thirty-five years. The harder the rock the more the danger. Those who work piece-work succumb the soonest. Death is principally due to pneumonia and consumption. One-fourth of the weight of the lungs of a rock driller at death has been found to be due to silicia, that is, inhaled rock dust.
>
> "Employers should co-operate in lessening the incidence of these diseases among this class of workers by (1) employing men of sound constitution, and particularly should attention be given to this point in case of youths, (2) inform the men of the dangerous character of this work, (3) arrange for periodic medical examinations, (4) all machine-planing, as well as sawing, should be done in the wet (perhaps using mineral oil), (5) stone-mason's sheds should be cleaned out and made free from dust each day, (6) openings to the shed should be at the floor or not higher than three feet from the floor, so that the dust, which is rather heavy, will not rise to the breathing level when it is blown out, and (7) where mechanical power is used, fans should be installed and air delivered above the heads of the men so that the dust is blown downward, while locally applied exhaust systems can be used in several processes of the work. The employe should breathe only through his nose, and, when inhalation of dust is unavoidable, should wear a wet sponge or other form of respirator. All the schools in a stone area should give special lessons on the danger of dust, upon proper methods of breathing, while medical school supervision would find the cases of obstructed nasal breathing during youth."

STONE SAWING. — This was a mechanical procedure wherever it was done on a large scale, and was usually done in the wet. The chief hazards were standing in wet stone-dust and water and the weather exposure. *Fatigue* was not much of a feature, although hours were longer than at Stone Surfacing in some places. The general *appearance* of the workers was fair to good. In some instances the workers were close to the saw and inhaled dust, which escaped the moistening process.

STONE CURBING. — The stone planers created abundant dust.

STONE CUTTING, CRUSHING AND GRINDING. — These processes were done in more or less open sheds or buildings, usually upon the edge of the quarry. Inordinate exposure to stone dust was the principal hazard. Hand cutting was both dusty and dangerous, while cutting machines did not appear to create much dust. Crushers and grinders were bad. It is difficult to circumvent this, particularly during filling and dumping of crushers, bins, etc.,

except by wearing respirators. No workers predisposed to tuberculosis should be so employed. Medical supervision would keep many who are predisposed to lung diseases out of the industry. In 1 place, employing only 5 persons, our investigators were certain that 2 of them were suffering from consumption. Many workers were reluctant to wear respirators. Again others protected themselves quite well by wearing a large sponge on the nose and mouth. Another hazard was the absence of proper sanitary conveniences for this class of workers, because of which hookworm disease as well as typhoid fever are greatly predisposed to. (See special report elsewhere "Industrial and Communal Typhoid Fever.")

GRINDSTONE MANUFACTURE.

Grindstones are cut and trued from certain forms of natural stone, the abrasive qualities of which are suited to the purpose. The making of grindstones is a feature of stonework in certain quarry districts in the state. The only reason that we mention it separately from the Marble and Stone Industry is because it is an industry more or less peculiar to the state. As noted in connection with 4 establishments, the following features obtained. A relatively small number of men were engaged entirely in the grindstone work. Modern labor saving methods were in use. They were no unions. The general attitude towards workers, the type of workers, and their steadiness at the trade was fair to good. The work required no particular skill. In 2 places blower systems existed for removing dust at its point of origin, but a large part of the work was done under water-grinding, and practically in the open air, or under loosely constructed sheds. In all places, however, stonedust was a fair to bad hazard as a contaminator of the atmosphere, at times, in the vicinity of the workers. Air conditions were about the same as those of the weather. Some piece-work was done.

Comments. — As stonedust is one of the most dangerous dusts which we have, because of its hardness and sharp-angled character, every effort should be made to prevent workers from breathing it, including the wearing of respirators, if other means will not suffice. Persons with a tendency to lung trouble should keep out of the industry, both because of the dust, and the weather exposure. (See also Stone Surfacing.)

EMERY WHEELS.

The making of emery wheels was investigated in 2 establishments, employing a total of 112 persons, all males. The various processes were Emery Mixing, Emery Wheel Truing, Furnacing (Kilning), and Babbitting. The last 2 processes were practically the same as considered under these headings elsewhere.

Emery Mixing. — This process was found to be very *dusty,* and the dust composed of the most harmful ingredients known, although they were not poisonous. The harmfulness consisted in the hardness, crystalline character, exceeding fineness and consequent contamination of the atmosphere. While there were hoods for controlling some of the dust, they were generally very inefficient. The principal components of emery wheels are corundum (Al_2O_3) and carborundum (SiC), clays and shellac, which are selected because of their abrasive qualities which depend upon their almost diamond hardness.

A very adhesive cement is used to hold the particles of emery together, as the wheels are molded. In the places investigated a great mount of dust was also "kicked up" from the floor underfoot. The workers were engaged at piece-work. There were no cuspidors. Washing and other *sanitary* facilities were very inadequate, although time was allowed for washing in one place. The workers made no *complaints*, but a number of them appeared very much under par in health.

Emery Wheel Truing. — After the wheels have been made and baked they are trued by grinding processes — another exceedingly *dusty* procedure. Protection from the dust was not efficient in either place, while it was also kicked up from the floors. In addition, the workers were exposed to the fumes from the lead babbitting bath in the same quarters in 1 place, where the investigator found 2 cases of undoubted *lead poisoning*. The babbitt metal was used for bearings for fitting the wheels to spindles or shafts. *Complaints* were also made of abdominal pains, constipation and digestive disturbances, as well as the effects of the dust upon the lungs. *Comments.* — A more efficient exhaust system would take care of practically all of the dust. In addition, general cleanliness of quarters, better washing facilities and precautions against lead poisoning would render the industry comparatively safe. The *Kilning* had practically no hazards to health, being a very simple procedure without undue heat, although smoky.

PORCELAIN ENAMELING OF IRON WARE.

This process consists in mixing dry ingredients and making up a lead-fritted glaze, then painting or "slushing" it on iron ware (bath tubs, sinks, utensils) previously roughened by sandblasting. The ware is then furnaced until red hot, then sprinkled or sprayed over with a richer lead glaze in the form of a powder. This furnacing and resprinkling is repeated several times, as a rule.

The process was investigated in 5 establishments, in 3 cities, where a total of 504 workers, all males, were found to be so employed.

There were no unions. The general attitude toward employes appeared good in 3 places, fair in another, and quite indifferent in the remaining 1. The general type of workers (the majority skilled) was good in all places. The retention at work was good in 3 places, but not so in the remaining 2. Health appliances were good in 1 place, fair in another, and absent in the remaining 3. Instructions, especially concerning lead poisoning were well given in 1 plant, but practically no attention paid to this in the other 4. Benefit organizations existed in 2 of the 5 plants. Work quarters were hygienically built in all places and the separation of sub-processes was also fairly well carried out. In only 2 plants were workers (1 or 2) noted who were over 40 years of age. Some youths under 20 were, however, present.

In 2 plants the *dust* was well enough controlled, either by means of hoods and exhausts (particularly the mixing and grinding processes), and by the wearing of respirators, to minimize hazards, but in the remaining 3, particularly in the sprinkling on of the enamel, it was bad. The content in all places was rich enough in lead to cause poisoning, although the solubility of the lead was reduced by its being added before the glaze was fritted. Quarters, especially the floors, were kept well *cleaned* in 2 places, and not so in the remaining 3. General room *ventilation* was good in 3, and fair in the other

2 places. Protection against *heat* was fairly good in 2 places, but not so in the remaining 3, where workers seemed compelled to "grin and bear it." Though the exposures were not long at any time, they were frequently alternated by going out into the *cold.* Except upon heavy ware the work was not unduly *fatiguing.* The workday was in 6-hour shifts in 1 place, 8 hours in 2 others, 9 hours in 1, and 10 hours in the remaining 1. The shorter workday prevailed in all places where the work was laborious. The liability to contracting *communicable diseases* was considerable in at least 2 places, due to promiscuous spitting into the dust, the absence of cuspidors, the very meager washing facilities, poor toilets, and common drinking cups or jugs. The risk of *poisoning* concerned lead entirely. Practically all through the process the workers were in danger of lead poisoning, from the opening of the barrels containing lead oxides, through its mixing, fritting, grinding into powder, to its application to the ware. Hanging clothes in the workroom, eating in the workrooms, and poor washing facilities were other important factors. The industrial inducement to *alcoholism* was in proportion to the poison factor largely, to which were added the other influences of dust, heat and fatigue.

The general *appearance* of the workers averaged good in 2 places, fair in 2 others, and poor in the remaining 1. They made few *complaints* and were inclined to accept poisoning as a necessary risk. A very few were at all posted in the personal hygiene of preventing poisoning. Our investigators found *8 cases of lead poisoning,* with evidence which pointed to a fatality in 1 instance due to lead poisoning. This was in a young worker who had been employed but a short time. *Comments.*—Definite instructions to workmen upon the prevention of lead poisoning, hoods and exhausts in mixing and grinding processes, wet cleaning of quarters often, the wearing of respirators while sifting on enamel, face shields with goggles, frequent rest intervals, medical supervision (consisting at least in a monthly five-minute examination for signs of lead poisoning, and the alternation of work where symptoms occur), and keeping boys out of the enameling furnace quarters, are the suggestions made. Furthermore, for all hot process workers shower baths should be provided and workers educated (if necessary) to their correct use.

MIRROR MAKING.

The process of making mirrors is very limited in Ohio. Our investigators reported upon 5 firms, in 3 cities, employing a total of 89 workers, all males. The work was semi-skilled, and the making of mirrors was the only process done at the places. The hazard, *poisoning,* was found to be a small factor, since in all places the work was done with silver nitrate and tartaric acid, mercury not being used. General sanitation and other hygienic features were below standards in all places, especially the general room *ventilation* and the methods of taking care of the fumes which were created. One workman complained of the nitric acid fumes from which he was not protected. In the silvering rooms the *temperature* was upwards of 80° with rapid changes by workers to cooler rooms. The grinding, bevelling, polishing and buffing, were done in the wet with a "rouge" paste, and in some places the quarters were very *damp.*

SOAP MANUFACTURE AND BY-PRODUCTS.

Soap manufacture and its by-products, consisting of special cleaning compounds, glycerine, candles, and in one or two instances, perfumes and talcum

powder manufacture, were investigated in 11 plants, located in 3 cities, and employing a total of 1,053 wage-earners at these processes, 697 males and 356 females. Usually soap works were independent industries, but some were connected with fertilizer and packing establishments.

This was an industry employing advanced methods in all except 2 small plants. There were no unions. The attitude toward employes seemed good in all places. A good class of workers was employed in all except 2 small places. The workers appeared to remain well at the work. Health appliances were present and very good in half of the places, and consisted of hoods over vats, tanks and dusty processes, as well as the use, to some extent, of respirators. Organized health instructions, placards, etc., were features in 4 places. In 2 large places sick benefit associations existed. The workers were very largely unskilled labor, although some might be considered semi-skilled. Work-places were hygienically constructed in all except 3 small places. In the smaller places various processes were performed in the same quarters. Age-group summaries showed 94 over 40 years of age and 959 under 40, with a fair number under 20, especially girls.

In 4 plants *dust,* composed of silicates, alkalies, and soap was negligible as a health-hazard, and fairly so in 4 others, but in 3 places employing a total of 60 persons, dust was very bad. Quarters were kept *clean* and orderly in 6 places, fairly so in 2 others, and not so in the remaining 3, the latter all small places. *Dampness* was no hazard in 7 places, was some feature in 3 places, and bad in 1 place employing 3 persons. Quarters were well *lighted* in 8 places, fairly so in 2 more, and not so in 1 small place. General room *ventilation* was good in 3 places, fair in 4 others, and bad in the remaining 4, due to closeness and confinement, as well as to fumes, alkali vapors, essences, etc. *Heat* was not much of a hazard in any place. *Fatigue* was a fair hazard in practically all establishments, due to various factors which may be given in descending order thus: constant standing, monotony, piece-work, speeding up, strain, chairs without backs, jarring processes, and work requiring pressure against the body. The workday was from 9 to 10 hours in all places; the noon recess was ¾ hour in 3 places, and ½ hour in the remaining 8. Overtime was seldom done. The liability to contracting *communicable diseases* was negligible in 2 of the larger places, fairly so in 4 other places, but was a bad hazard in 5 establishments, due chiefly to the use of common towels and drinking cups, inadequate washing facilities and poor closets, promiscuous spitting, the absence of cuspidors, and for some workers, the handling of infectious materials (carcasses, hides, etc.). Medical supervision of employes obtained in 2 large plants. The exposure to *poisoning* was a bad feature in 2 small places, and fairly so in 4 other places, due to alkali ($NaOH$ and KOH) vapors and dust, fatty acids, and perfume essences. Exceedingly nauseating vapors were also encountered. The poison hazard could have been overcome by mechanical means and also good washing facilities. The industrial inducement to *stimulantism* was some factor in 6 smaller plants and especially in those where the breathing of irritating dusts of alkaline character was a feature.

The general *appearance* of workers in the soap manufacturing industry was good, with the possible exception of 3 small places, where *complaints* were made of nausea and loss of appetite, the irritating alkaline fumes, stearic acid vapors, and soap-dust upon the lining of the nose and throat, upon digestion, and upon the skin and scalp. New hands appeared to complain of nasal dis-

charges, sore eyes and coughing, in quarters were perfumed soaps were made. Soap powders were more irritating in warm weather and especially to persons with hay fever tendencies. *Comments.*—Soap workers in dusty processes should wear caps to protect the scalp from "salt rheum" or chronic eczema. The vast majority of workers in this industry, however, were found to be engaged under the most excellent work and social conditions, including air-conditioned work rooms, process ventilation systems, recreation features, social welfare, profit sharing, etc.

BAKERY PROCESSES.

While various manipulations make up Baking Processes as carried on in factories (no small "home bakeries" are included here), it is considered best to group them all under this head and point out differences in sub-processes as necessary.

Baking was investigated in 8 plants, in 4 cities, employing a total of 639 wage-earners, of whom 455 were males and 184 were females. Bread, crackers, pastries and, in one place, confections also were the products made. In all plants most modern methods were adopted, with the possible exception of some of the processes in 2 plants. There were no union organizations. The managerial attitude toward the welfare of employes seemed very good in 5 places, fair in 2 others, and rather indifferent in the remaining 1. The types of employes had about the same grading. In all except 1 place, endeavors were made to keep the same employes, and the latter appeared to remain steadily. Health appliances consisting of aid-conditioning systems for certain rooms, fans and exhausts were good in 3 places, but practically absent in the remaining 5. Organized instructions in the care of personal health were given in 1 place, while a sick benefit association existed in another. Work quarters were hygienically well constructed in 6 places, and fairly so in the remaining 2, although certain rooms could have been much better built for the purpose. There was a general commingling of processes in 6 places. Age-group estimations summed up as follows: over 40 years, 106; 20 to 40 years, 488; and under 20 years, 45. There was a tendency to employ young girls.

In 3 places workers were exposed to considerable *dust* in certain starchy processes. *Cleanliness* and orderliness, which are prided features of this type of industry, were found below expected standards in 2 places, and especially so in 1. Certain dirty habits, such as the dripping perspiration into the dough were observed. For a considerable number of workers *light* was poor in 3 places. The general room *ventilation* for the various processes was good throughout in 5 places, fair in another, but poor in certain parts (mixing and baking) in the remaining 2 places. *Heat* about the baking ovens was a negligible hazard in 2 places, fairly so in 3 others, but in the remaining 3, workers were subjected to an undue amount of heat, particularly since they were employed for long hours in such quarters. Quarters were insufficiently heated in parts of one plant. As the work was conducted, *fatigue* appeared no factor in 2 plants, and but a fair hazard in 3 more, but in the remaining 3, employing a total of about 110 persons, several fatigue factors did obtain—chiefly, constant standing by the girls in wrapping and packing, hurrying piece-work, and monotonous application. The workday was 8 hours in 1 place (which also allowed ¼ hour recess each morning), 9 hours in 3 places, and

10 hours in the remaining 4 places. The noon recess was 1 hour in 2 places, ½ hour in 3 places and "no regular" in the remaining 3. Overtime work was occasionally necessary and in 1 large place at least no compensation was given for this. The liability to contracting *communicable diseases* appeared no hazard in 3 places, while in the remaining 5 there was some risk in various parts, especially in 2, due to such factors as the presence of swarms of flies, the use of common drinking cups, common towels, inadequate washing facilities and toilet arrangements, spitting upon floors, and the absence of cuspidors. Usually, these last two features in particular were carefully supervised. In 2 large places there was a medical supervision of workers. The short-intervaled handling of bakery products by workers was another feature which especially necessitated medical supervision. In no places were workers found exposed to *poisons,* although in some quarters ovens were not well ventilated. The industrial inducement to *alcoholism* appeared some feature in 3 places, due chiefly to the absence of good drinking water properly cooled and plentifully supplied, and, for different groups of workers, the depressing influences of certain of the hazards above named.

The general *appearance* of workers averaged very good in 6 places, fair in another, while in 1 place (which was small) some of the workers were quite worn, fatigued and anemic looking. Workers made few health *complaints* at any place, although evidences of tuberculous persons, engaged in such baking establishments, were brought to our attention and are reported elsewhere. *Comments.* — The shortcomings above mentioned in certain places suggest their own remedies. Even though females engaged at piece-work processes may prefer to stand most of the time, they should be given instruction in how to stand in order to prevent flat foot, other deformities and internal derangements, while they should also be supplied with chairs with back rests. While starch and flour dust are practically harmless as such, any workers who are predisposed to consumption will likely have such disease awakened from the coughing which the dust incites, particularly when other conditions of heat and work are combined. In a number of oven quarters ventilating hoods could be constructed, which would entirely relieve the workers of heat influences; or air blasts and fans might answer. As for all hot-process workers, they should be supplied with shower bath facilities.

CONFECTIONERY PROCESSES.

The making of candies, sweetmeats, nut preparations, and other confections was investigated in 14 establishments, in 3 cities, employing a total of 1,359 wage-earners, of whom 392 were males, and 967 were females.

Thoroughly modern methods appeared to be adopted in 11 places, and fairly so in the 3 remaining. There were no union organizations. The attitude toward employes, the type of employes, and the retention at the work appeared good in practically all places (spring and summer being dull seasons). Health appliances consisting of air-conditioning apparatus for workrooms, fans, hoods, vents, and exhausts were present and very good in 5 places, fairly so in 2 others, but absent in the remaining 7 (all except 1 of which were small places, where workers were not continuously applied at the same processes). In 1 place shower baths were present. In 4 places considerable attention was given to health instructions, and nurses were employed. As a rule, girls wore caps and aprons, the latter changed twice

a week; men wore white overalls which they changed once a week. Men wore gloves in candy pulling. In 2 cities, Board of Health placards, showing city regulations for this industry were found posted up in workrooms. Several plants employed physicians who looked over employes at regular intervals. There were no factory sick benefit organizations in any plants. The general construction of work quarters was good throughout in 8 places, fairly so in 3 others, while of the remaining 3 this could not be said as respected certain departments. In 8 of the places various processes were intermingled in the same rooms, including some large establishments. The age-group estimations summed up as follows: over 40 years, 50; under 40 years, 1,309, of whom probably 15% were under 20 years (chiefly girls).

In 9 establishments *dust* was practically no hazard to any of the workers, but in the remaining 5 (especially in 2) workers upon gum drops, marshmallows, and in other starchy processes breathed a considerable amount of starch dust. Quarters were kept very *clean* in 8 places, fairly so in 5 more, and not so in the remaining 1, where some 70 persons were employed. In some places candy drippings were caked upon the floors, while dry sweeping during work hours was occasionally noted. In 1 place starch, which escaped, was swept back into the bins from the floor. In 3 places some workers were considerably exposed to *dampness* from the steam and humidity from cooking and dipping processes. In one cooking room the workers' feet were soaked with water and syrup on the floor. General *lighting* of quarters was also below standard in 3 places, due either to location of the building or the large size of the workroom so that interior portions were darkened. General room *ventilation* was good throughout in 4 places, fair in 7, and bad in some parts, in the remaining 3. The chief reasons for bad atmospheric conditions were the presence of free flames without vents, the necessity of keeping windows closed because of street dust and smoke, and the absence of air-agitators, exhausts or fans, where such should have been present. In 1 place, great, but misplaced, confidence was had in an ozone machine to purify the air. It is hardly necessary to say that ventilating experts as well as physicians have proven such methods entirely fanciful. In 8 places *heat* was no particular hazard to any of the workers, while in the remaining 6 it appeared to range about 85° for some. It came from the kettles and ovens. *Cold* was some hazard to a number of workers in a basement quarter. (For Chocolate Dipping see below.) The work was so conducted that *fatigue* was no factor in 4 places and practically so in 8 more, while in the remaining 2, employing some 300 workers, several fatigue factors were present. These consisted in hurrying piece-work, speeding up, monotonous application, constant standing by some workers, chairs without backs, long continued faulty postures, and, occasionally, heavy lifting, jarring processes and loud noises from press machines. In 1 place part of the workers had to climb to the sixth floor. A special barrel lift, shaker and emptier was used in one place to offset strain. The workday was found to be 8 hours in 3 places, 9 hours in 9 places, and 10 hours in the remaining 2 (for males). The noon recess was 1 hour in 1 place, 1 hour for females in another, and ½ hour for all workers in all other places. The liability to contracting *communicable diseases* seemed negligible in 2 places, fairly so in 6 more, bad in 4 (and not reported upon in 2). The predisposing factors were the use of common towels, common drinking cups, inadequate washing facilities, and, occasionally, lots of flies, poor toilets,

promiscuous spitting upon floors, and the absence of cuspidors. Candies were also handled at short intervals by different workers. Eating in workrooms was common, but some places prohibited it and provided good dairy lunch rooms. In no places were workers exposed to *poisons,* except such fumes as might escape from heating and cooking apparatus. The industrial inducement to *stimulantism* appeared some factor in at least 4 places, with the fatigue hazard the principal cause.

The general *appearance* of workers was good in 10 establishments, while a fair percentage appeared below normal in the remaining 4. Outside of the frequency of bad teeth (said to be due to eating of confections) our investigators reported no *occupational diseases.* Workers themselves made very few *complaints,* although it was said in some places that new workers lost their appetites from the odors present. Investigators reported nauseating *odors* in numbers of places, which arose from the syrups, baking processes, steam, etc

Comments. — In some cities municipal regulations prescribed caps, aprons and careful personal supervision of workers, particularly directed to the presence of venereal and contagious diseases. These should unquestionably be adopted in all places. On the whole, the industry was found to average up better than General Factory Processes as far as conditions affecting the health of the workers were concerned. More attention to ventilation of work quarters and to the fatigue question are suggested for a number of establishments.

CHOCOLATE DIPPING.—The process of making chocolates was found present in 9 establishments, the workers being divided as follows: cooking and hot processes, males 14, females 42; dipping, males 1, females 309; packing and shipping, males 21, females 233. The cooking and dipping processes did not differ materially from those of the candy industry in other departments. To facilitate hardening and subsequent handling and packing, a temperature of 65° was maintained in 5 establishments, 60° in 1, and from 60 to 68° in the remaining 3. In 5 plants, chocolates were dipped by machine. This machine conveyed them to another room, which was kept cool, so that only those who were employed at removing the chocolates and storing them in refrigerators were exposed to the cold. Hand dipping,, however, was done in the cool room. Packers sometimes worked in the cool rooms. It was said that one dipping machine would do the work of 30 hand dippers. Hand dipping was very sedentary work. Workers usually wore sweaters and other warm clothing in the cool rooms, but more of them should have been so provided. The chief hazard appeared to be to hand dippers who worked at hot chocolate kettles in a cool room. Another moderate hazard appeared to be alternate exposures to heat and cold, while the materials used were likely to produce skin irritations in certain susceptible persons. In 1 place, persons with a tendency to moist hands were not employed on chocolates. In another, tincture of ferric chloride was applied to the fingers for cuts, hangnails, etc., and to harden the skin.

CANNING AND PRESERVING. — PREPARING, SORTING, COOKING OF VEGETABLES, ETC.

This part of the canning and preserving industry consists in the various preparatory and cooking processes through which the materials pass. These are variously named, some of the names depending upon the types of produce

handled, etc., such as vining, picking, husking, shelling, stringing, cutting, peeling, sizing, washing, scalding, steaming, can cleaning, pickling and catsup making. These preparatory processes were found to engage a total of 559 wage-earners (males 169 and females 390) at the time of our inspections in 12 establishments which were investigated in 8 cities. In practically all of these, various machine methods were used to expedite the work, and especially so in the larger places. There were no labor unions. The general attitude of employers toward employes seemed very good in 7 places, fair in 4 others, and not good in 1 place. The general type of workers (especially in the catsup, preserves and jelly works, and also in a number of the vegetable canning and pork and bean works) was good in 8 plants, while a considerable percentage of ignorant help, consisting largely of foreigners, was employed in the remaining 4. The work was decidedly seasonal, but there seemed to be a considerable demand for help during the canning season, and in all but 4 places (including 1 or 2 large plants, however), workers appeared to remain fairly well for the season. In one plant it was said anybody could get a job and that consumptive persons got well on it!

Various forms of health appliances, consisting of hoods and vents over hot steaming processes, and for ventilation of quarters were found installed in 3 places, and to be quite efficient in 2 of them. They were absent in the remaining 9. Floor treads and floor drains were present but not in all places where needed. Instructions in matters of personal hygiene were given attention in 4 places, while there was also a city supervision in 3 of these. Females wore special caps and aprons as in the bakery and confectionery trades in some places. There were no sick benefit organizations. The general construction of work quarters was hygienically good in 6 places, fair in another, and poor in the remaining 5, the latter including plants of all sizes. Except in small places these processes were more or less subdivided into various rooms. At different seasons, different vegetables were handled with the same help and machinery. The age-group estimations summed up as follows: over 50 years, 25; 45 to 50 years, 42; 40 to 45 years, 100; under 40 years, 392, of whom probably 10 to 15% were under 20, most of the latter, females. It was common to find whole families employed in the work. In some instances "colonies" were imported even from outside of the state to work throughout the season, when men, women, and children were housed in company buildings.

While some of the vining, shelling and dry handling of vegetables created some *dust,* this was of an earthy character and quite negligible. Quarters were kept *clean* and orderly in 6 of the plants when visited, fairly so in 4 others, and not so in the remaining 2 (one large and one small plant). In vegetable canning, water, steam and *dampness* were a hazard in all of the places, and especially so in about half of them. Getting the clothes wet and standing in wet shoes were common observations. These factors differed in different departments of the work. Quarters were well *lighted* in 7 plants, but only fairly so for certain parts in the remaining 5. The general *ventilation* was good in 6 plants, and fair in the remaining 6, the chief reasons for fouling the air, where such existed, being the escape of odors, steam, gas, and occasionally solder fumes. *Heat* was a hazard to some of the workers in all places. It was rendered worse by the fact that most of the work was done in the warm season of the year. Many of the workers could not avoid passing from hot steamy quarters to cooler rooms, or outdoors, particularly in communities

where outdoor closets or privies were used. With the exception of 2 or 3 plants washing facilities were very meager, and such conveniences as shower baths for hot process workers were lacking in all places. *Fatigue* was the chief hazard of the process. This seemed to be especially marked for the great majority of the workers in 7 plants, and fairly so in 4 more. Particularly was this so in canning vegetables, rather than in making catsup and preserves. The chief fatigue features, arranged in as nearly descending order of importance as possible, were monotonous application, constant standing, absence of seats (or chairs without back rests, or even only boxes), speeding up, hurrying piece-work, prolonged faulty postures, long hours, lifting heavy baskets and crates (often by young persons), and, occasionally, loud noises from the rush of tin cans. The workday varied more in this industry than in probably any other investigated, as it depended largely upon the receipts of perishable goods, so that long hours, Sunday work, and overtime were frequently necessary, in which all workers (by law this is an industry in which the hours for females are not limited to 10 hours per day) were apt to be engaged. In 5 plants it was usually the rule to take 1 hour for a noon recess, while in the others, the length of this recess was more or less determined by the work on hand and the workers' piece-work obligations. In 2 plants night shifts were employed. As an instance of the long hours, an engineer at one plant said that it was the night watchman's duty to arouse him every so often at night to see that the boilers were in a safe condition. The liability to the contraction of *communicable diseases* seemed a negligible hazard in 1 place, fairly so in 3 others, but bad in the remaining 8, the chief features being the use of common drinking cups and towels, absence of cuspidors, promiscuous spitting, collecting of refuse outside of buildings, strong odors, swarms of flies, poor washing facilities, dirty roller towels, and filthy closets (in some places men used corn husks for toilet paper), finally, the lack of any medical supervision to intercept diseased persons. In a number of places conditions were such as to favor a low tone of morals, enhanced by the large numbers of persons of both sexes working together. Sore hands and fingers from working and peeling in water and steam, and from accidental cuts, were fairly frequent. The risk of occupational *poisoning* was nil so far as could be determined. In 1 place, however, Soldering was done in the same quarters. The industrial inducement to *stimulantism* was considerable to most of the workers in this industry, due, first of all to the fatigue hazard, after which the subjection to heat, moisture and dampness and meager sanitary arrangements were added, while in 3 places drinking water facilities were very inadequate.

At the time visited the general *appearances* of workers, as to health, averaged good in 7 places, and only fair in the remaining 5. However, this depended largely upon whether the plant was seen early in the season or not, and whether workers had been subject to several days of prolonged work just previously. It is conservative to state, however, that there were many workers in the total number who should have had a physician's certificate to be allowed to continue work longer. Very few of the workers were spoken to personally, and these took the position that all the hazards around them were "matters of course". None of them, of course, had any basis of knowledge upon which to assume that they were or were not fitted to the work at hand, or to the extent to which the work might be seriously damaging to the health.

Comments. — The spells of rush work in this industry make it necessary that all workers so employed should be physically normal, and perfectly able to withstand the stresses necessary. This can only be attained through a physical examination of workers at the time of employment. In addition, all deleterious conditions of environment, as mentioned above, should be given every thought toward eliminating them. It is recognized that the education of the employes themselves in their personal care and habits, and to accepting conveniences arranged for them, is a fundamental feature in bringing about a more perfect health standard among them.

CANNING AND PRESERVING. — FILLING, SEALING, PACKING OF VEGETABLES, ETC.

It is difficult to make process differentiations in the canning and preserving industry, but we have found it advisable to make two sub-divisions: (1) Preparing, Cooking, etc.; and (2) Filling, Sealing, etc. Under the latter head are included capping, bottling, corking of catsups and jellies, and "canning" or packing, inspecting (for leaks), sealing, soldering, final sterilizing, labeling, weighing and packing. In the 12 establishments investigated, there were found to be a total of 252 workers in this second set of subprocesses, of whom 117 were males, and 135 were females. The same general conditions concerning the workplaces and the character of the workers obtained as before described. The differences in hazards in this division were that water, *dampness* and steam were usually considerably less. Quarters, also, proved to be better *lighted*. Exposure to *heat* was about the same. The *fatigue* features were also practically identical. There was a greater liability to lead *poisoning*, due to the soldering machines, and processes, but in only 1 place did this appear to be a bad hazard. Here it was all hand work. In machine soldering, as elsewhere, the risk was limited since workers were not so close to the fumes produced, while the personal factor of carelessness in handling and even chewing strips of solder were present. The general *appearance* of workers was the same as in other departments. *Comments.* — There is the same necessity for hoods and vents over steam and fume processes, and for medical supervision as mentioned in the other processes of the work.

CARBONATED WATERS. — COMPOUNDING.

The compounding of carbonated waters was investigated in 4 establishments, one of which was a brewery. The process was found to employ but very few persons, — a total of 14 being in the 4 places. Sometimes the same workers were also engaged in bottling. In 1 place the work was done at mineral springs. There appeared to be no hazards connected with the work, and premises were usually in good conditions, although flies were noted in 1 place due to the absence of screens. In one instance a consumptive was reported who was found to be engaged as a labeller of bottles.

ICE MANUFACTURE.

The manufacture of artificial ice was investigated in connection with the ice business, cold storage, brewing and bottling. In the 14 plants seen, located in 3 cities, there were a total of 164 wage-earners employed, all males,

at the ice manufacturing work itself. The ammonia and brine processes were used. About 60 percent of the ice manufactured was used at once and the balance placed in storage. The workers were members of union organizations in 8 places. The general attitude of employers toward the welfare of workers appeared good in 10 places, fair in 3, and questionably bad in 1 only. A generally intelligent class of workers was employed in 7 places, and fairly so in the remaining 7. Workers appeared to remain fairly constantly at all places, although the work was seasonal for a considerable percentage of them. Some health appliances were present in a few places. In one, all ice was handled and stored by machinery. There were shower baths in 3, while safety helmets (to use in cases of accident to the ammonia apparatus) were at hand in several places. In 2 plants, some attention was given to instruction of employes in matters of personal health. There were no sick benefit organizations.

The chief hazards were found to be water, steam, and *humidity,* combined with exposure to *cold,* due to the nature of the process. Temperatures ranged from 0 to 50 degrees Fahrenheit, being lowest in cold storage quarters for meats. Probably the main cause for ill health, was the more or less frequent alternations between cold quarters and the warm exterior. *Fatigue* was a factor for most of the workers, due, chiefly, to the laborious character of the work, long hours, more or less monotonous application, as well as strain and prolonged standing. Usually there was some diversity of work. The workday was found to be 8 hours in 4 places, 9 hours in 1 place, 10 hours in 1 place, and 12 hours in the remaining 8 places. In 5 places night shifts were present. Seven days a week and no time off for Sunday was the custom. The noon recess was 1 hour in 6 places, ½ hour in 6 more, and more or less "as desired" in the remaining 2. A morning recess was taken in some places. The liability to contracting *communicable diseases* was a fair hazard in some 8 of the establishments, due to such factors as the use of common towels, common drinking cups, very poor washing facilities and closets, and, less often, to the absence of cuspidors and spitting into dry places. First-aid equipments for injuries, cuts, bruises, etc., were more or less provided for in some places. The liability to *poisoning* was limited to the exposure to ammonia gas, but this was no hazard unless leaks or the breaking of carboys occurred. As stated, gas helmets were supplied in some places to meet such emergencies. The industrial inducement to *alcoholism* was more or less considerable for practically all workers, due to the fatigue factor, the wet and chilling character of much of the work, and the permitting of liquor drinking during work hours, in some places.

The general *appearance* of workers averaged up fair to good in all places, although a number of workers were seen who were questionably below par in health. The chief *complaints* of the workers were long hours, Sunday work, and "cannot keep feet dry" (and as a result of this hazard) the great frequency of rheumatic afflictions. *Comments.* — Workers who enter this industry should do so only after being advised by a physician that they are normal, and capable of performing the work without predisposing themselves to health disasters. In the course of the work, shorter hours in about half of the places, good equipment of boots and aprons, and avoidance of alternation between cold and warm places must be given serious consideration.

LIQUORS, MALT. — BREWING.

The brewing of beer was investigated in 9 establishments, in 3 cities, in which 115 men were engaged in this process. In all places the most improved modern methods appeared to be in use, and the workers all belonged to unions. The general attitude toward the welfare of employes seemed very good in 6 establishments, fair in 2 others, and quite indifferent in the remaining 1. An intelligent type of employes composed the work shifts in all places, and a certain amount of skill was necessary. In 7 of the 9 places the workers were practically all old-time employes, while in the remaining 2 there seemed to be a considerable amount of changing. The business is not one requiring anything special in the way of health appliances, except that arrangements for special ventilation should be at hand when necessary to clean kettles, and the like. There were no sick benefit organizations, except such as obtained through the unions.

The process usually occupied 2 to 4 floors, although bottling and inspecting were carried on in the same quarters in 2 places. The age-group estimations of employes summed up as follows: over 50 years, 6; between 45 and 50 years, 6; between 40 and 45 years, 19; between 20 and 40 years, 61; and under 20 years, 23.

Of the general hazards, *steam* and *humidity,* which are both necessary features of the process, were a fair risk. Two places had air-conditioning systems, change rooms, lockers, and good washing facilities to protect workers from the effects of the hazard. Quarters were somewhat *warm,* especially in the summer season. The going into *cold* storage cellars from these warm steamy quarters was the worst feature. The milling room was usually very *dusty. Fatigue* could not be considered a hazard at all. The workday was 8 hours in all places, with a 1-hour noon recess. Night shifts existed in 2 places. The risk of contracting *communicable diseases* appeared negligible in 4 places, but present in the remaining 5, due to poor washing facilities and toilets, the use of common towels, and to some spitting about. There was no apparent risk of *poisoning* in the process. A 5% solution of sulphuric acid was used after each brew to clean out the kettles, when a worker might remain inside for an hour. The industrial inducement to *alcoholism* was, of course, considerable in all places, since the drinking of the beverages was allowed during work, while the subjection to depressing influences of humidity and heat favored it.

The general *appearance* of workers was graded as good in 4 places, and at least fair in the remaining 5. The workers made no complaints. *Comments.* — Arrangements should be made whereby workers do not change from hot to cold work, for the supplying of good boots where needed, for good washing facilities, including shower baths, and for the better removal of steam and water in some places. A much smaller limit should be put on the amount of beer allowed to be drunk, for, although actual intoxication was usually a cause for discharge, there is no question but that most of these workers drank too much of the beverage to maintain a physiologic status.

COLD STORAGE. — Storage and fermentation cellars, keg and bottle-filling rooms (and occasionally wash houses) were kept at a temperature of 32° to 40° F. They were very damp. Ammonia leaks from the cooling system occasionally occurred, and some plants had no helmets or air apparatus to pro-

tect workers while repairing such leaks; cellars were darkened, and poorly ventilated since windows and doors were kept closed. Storage casks were shellaced yearly or so when the great danger of wood alcohol *poisoning* was present. Some firms used a suction pump to remove fumes, and pure air was admitted by means of an opening in bottom of casks. Only a few men remained constantly in cellars although in smaller places those from brewing quarters were going in and out of cellars. Rubber boots and woolen clothes were usually worn.

LIQUORS, MALT, AND CARBONATED WATERS. — BOTTLING.

Inasmuch as bottling is practically the same, whether malt liquors or simple carbonated waters are put up, this process is considered as one. In fact, in some breweries, simple carbonated waters were bottled, as well as malted beverages. Other breweries did no bottling at all.

As investigated in 7 establishments, located in 4 cities, the bottling was found to engage 280 men. Unions existed in the breweries. Mechanical methods were used in all places. The general attitude towards workers seemed fair to good everywhere; the same applies to the type of workers and their retention at the process. In 4 places some health appliances were present, such as air-conditioning systems, good floor drains, etc. In 2 places (carbonated waters) instructions concerning health and personal hygiene were given, while first-aid equipments were present in practically all places. Bottling quarters were hygienically well constructed in 4 places, fairly so in 2 more, and not so in 1 large brewery. Other processes were present in 1 or 2 places, such as washing of bottles, sorting and Labeling. The age-group estimations of this class of employes summed up as follows: over 50 years, 2; 45 to 50 years, 4; 20 to 40 years, 274 (in the latter there were some under 20 years). The work was unskilled.

The principal hazard was exposure to water, steam and *dampness*. This was more marked in the breweries. In 2 breweries the bottling quarters were only fairly *clean* and orderly, while one small place was very dark. General room *ventilation* was fair to good throughout. The work could not be considered *fatiguing*, although constant standing was the rule. The workday was 8 hours in 5 places, and 10 hours in the remaining 2 (both carbonated water plants). The noon recess was 1 hour in 6 places, and ½ hour in the remaining 1. Overtime was seldom resorted to. The liability to contracting *communicable diseases* was about the same as described under Brewing. There appeared no risk of *poisoning,* although the presence of lead in bottle caps was not, unfortunately, inquired into. The industrial inducement to *alcoholism* was marked in all of the breweries.

The average *appearance* of workers seemed good in 4 places, fair in 2 others, while not good in 1 small place. The workers made practically no *complaints* concerning the effect of the work upon health, except the dampness and getting the feet wet. In some of the places, sanitary conveniences were excellent, such as marble toilets, steel lockers, floors flushed every night, etc. *Comments.* — The chief risk in this process would appear to be the personal factor, that is, the extent to which workers imbibed of the beverages produced, and the protection of the person against dampness.

LIQUORS, MALT. — KEG FILLING.

Low *temperature,* water and *dampness* characterized this process, while there was the same inducement to industrial *alcoholism* as elsewhere. In some places workers in bottling rooms also were subjected to low temperature. Filling, adding caramel, corking, labeling, pasteurizing, and crating were the sub-processes. In one plant an excellent air-conditioning system was present in all quarters, lifting of kegs was done by machinery and there was a lunch room to which all workers were required to go to eat.

LIQUORS, MALT. — KEG WASHING.

In all breweries a certain number of men are engaged in the washing of beer kegs. In large places this in done mechanically. In 7 places investigated. there was a total of 61 men so employed, 4 of whom were over 40 years of age. The work was done in poorly constructed parts of the building in 3 places, and in practically all the places the workers were subject to standing in *water* and getting their clothes wet. In one place on the floor the water was 3 inches deep. In 4 places the *light* was not good. In the same number of places *heating* methods were inefficient for the cooler seasons. The work did not seem unduly *fatiguing,* and an 8-hour day was observed in all places, with 1 hour for noon in 6, and ½ in 1 place. While the men *appeared* fairly healthy in all places they were very wet and dirty in some. The chief *complaints* were rheumatism and other effects from the wet character of the work, and the subjection to both hot and cold water. Numbers of them said they were constantly wet. *Comments.* — In order to insure that such employes are properly clothed, this feature should probably be taken in hand by the employers, and good boots and aprons provided. Obviously, proper heating, good light, etc., are necessary. In 1 place all lifting was done by machinery. As with other departments in the brewery business, most of these workers drank entirely too heavily of beer.

The RELINING of KEGS with hot pitch and resin subjected a few workers to the irritating effects of the smoke and fumes from this process. One pale and anemic worker was found so engaged who made considerable complaint.

TOBACCO. — MOISTENING OR "CASING".

In practically all tobacco and cigar factories the tobacco is soaked up, moistened or sprayed with water, then placed in cases (trays) and laid away to flavor. Sometimes weak acids, ammonia, wine, etc., are added. But a very few persons are employed at this even in the largest plants.

There were found to be 15 men engaged at this work in 5 of the larger plants investigated. They were usually old time employes, and 7 of them were found to be over 40 years of age. The work was usually done in the basement or some side room, the general surroundings of which were a healthy place in which to work in only 1 instance. The work required very little skill. In 1 place there were local exhausts to remove tobacco vapors which arose.

The chief hazards of the work were its very wet and sloppy character, its location in usually very poorly and illy ventilated quarters and the lack of proper clothing which the workers wore to prevent wet feet, and wet garments. Workers complained of rheumatism and poor floor drainage. They

were also constantly handling strong wet solutions of tobacco and its principles, and were probably most exposed to these, both through skin absorption and inhalation of vapors, of any of the workers in the industry.

TOBACCO. — STEMMING.

The stemming or stripping of tobacco leaves is one of the preliminary processes in the manufacture of cigars and the various forms of tobacco put upon the market. In a few instances machines which were said to be more or less satisfactory were used to do this work, but the vast amount of it was done by hand. Very little skill was required, except for binders and fine wrappers, although experience developed considerable dexterity. In many places, especially in the larger cities, foreign women of all ages were employed at this process. They were accustomed to sit on low stools or boxes within low stalls, surrounded by the heaps of tobacco leaves. In one place which did this as an exclusive process (outside of packing and shaking) a good class of girls were employed at benches. Their stools with straight board backs, however, were not at all comfortable. The process was investigated in 22 establishments located in 9 cities, and was found to engage a total of 1,053 wage-earners, of whom 160 were males and 893 were females. Men were more apt to be employed in smaller places, and in miscellaneous "tobacco" rather than cigar works. In 2 of the plants investigated there were union organizations; here strippers and banders were the only females employed. As nearly as could be judged the managerial attitude toward the welfare of this class of workers appeared good in 17 places, but more or less indifferent in the remaining 5. In 10 places a fairly intelligent type of workers was employed, but in the remaining 12 a large percentage of ignorant help, mostly non-English speaking foreign women were engaged. In 2 establishments there were some forms of health appliances, such as exhaust hoods over the piles of leaves as they were shaken out. In 3 places some organized health instruction was given. In none of the cigar factories were there sick benefit associations. Such were present, however, in 2 tobacco works. The general construction of workrooms was hygienically good in 6 places, fairly so in 7 more, but not so in the remaining 9, which included some large as well as some small places. Particularly, were old types of factory buildings with low ceilings, small window space, and rough floors at fault in this respect. Outside of small places this process was usually in quarters by itself, although in two instances in large establishments some preparing and Cleansing, Rolling and Bunch-breaking were carried on in the same room. The age-group estimations summed up as follows:

Age-groups.	*No. Wage-earners.*
Over 50 years	33
From 45 to 50	53
From 40 to 45	109
Under 40	858
	1,053

About 5 per cent of those included in the last group were under 20 years of age, hence there was a tendency to employ older persons at this work.

The work is slightly *dusty,* the dust coming more from the floor accumulations than from the stripping of the tobacco leaves which are more or less moist. In addition to this, however, some 15 places were littered up with *dust* and *dirt* over the floors, on window ledges, rafters, lamps, etc., while in 12 places, at least, considerable more attention should have been given to *cleaning* of quarters. In 1 place employing some 35 persons quarters were quite *damp,* due to the proximity of the workroom to the tobacco casing process. In 19 places the *lighting* of work quarters (naturally or artificially) was good, while it was bad in only 1 place. However, artificial lighting was usually by naked electric lamps suspended by cords from the ceiling or by gas jets. The *ventilation* of work quarters was good in 4 places, fair in 9 others, but bad in the remaining 9. This was due principally to stagnation of the air to which were added abnormal temperature-humidity relations and contamination with tobacco dust and odors as well as fouling with the breaths of many persons working somewhat close together. In 5 places quarters were unduly warm particularly in summer time, due to locations and weather-exposed quarters under low ceilings or roofs. All places were, as a rule, sufficiently well heated for winter work. *Fatigue* was a hazard in all places and apparently more so in 10 places than in the remaining 12. Its chief causes arranged in descending order were: monotonous application, faulty postures (usually in a stooped position seated on low stools or boxes, which necessitated the extension of the feet and limbs out in front of the worker), and hurrying piece-work. Less often were noted constant standing and evident speeding up. In very few places were there any backs to the boxes or low stools on which the workers sat. The workday was 8 hours in 6 places, between 8 and 9 hours in 9 places, and between 9 and 10 hours (and occasionally longer) in the remaining 7 places. It was difficult in some places to find out the length of the workday, for apparently workers were allowed to come early and start to work and to continue with practically little restriction as long as they wished. They probably did not exceed 10 hours very often. This was found to apply to the noon recess as well. This recess as nearly as could be ascertained ranged as follows: 1 hour in 13 places (in some places insisted upon); ¾ hour in 3 places; and less than this in the remaining 6. Workers were usually accustomed to suit themselves about other recess periods for light lunching, etc. However, the necessity for continuous work in order to make "a day's wages" resulted in our investigators seeing very few persons idling. The *sedentary character* of the work was also a very detrimental feature of it, from the health point of view. In most places the stock was brought to the workers and the stripped leaves removed without their having to get up to do the same. The liability to *poisoning* concerned the tobacco element entirely and was not materially different from that described for the workers in the rolling and similar processes. The industrial inducement to *stimulantism* was marked in 20 places at least where the fatigue factor, combined with inactivity, the breathing of tobacco vapors and dust, and the depressing influences of poor ventilation, as described, were the chief incitors. There was some complaint of alcoholism among this class of workers. In 2 establishments, however, practically none of these deleterious factors existed. The liability to contracting *communicable diseases* was negligible in 7 places, but a hazard in the remaining 15, and particularly so in 7. The chief reasons were the crowding together of numbers of workers into the same room which was dirty and dusty, and where no medical supervision obtained to keep out persons suffering

from consumption or other communicable maladies. In addition there were common drinking cups and the use of the same towels, often, also, very poor washing facilities and toilets. In only a few of the places where men were employed were there any cuspidors. There appeared a slight risk of conveying infection by means of the materials handled, but this was usually not short-intervaled enough to be of moment. In some places men and women were employed together and in some of these the morals seemed open to question.

The general *appearance* of workers averaged well in 10 places, while in the remaining 12 there were a good many pale, anemic, or otherwise unhealthy looking workers. They were more noticeable in poorly ventilated quarters. It was difficult to get much information from employes concerning the effects of the work upon their health since large number of them could not speak English and most of the balance appeared very reticent, particularly in the presence of their employers. The *complaints* gathered were: digestive disturbances; sickness and fainting; that new workers were most affected; and that female disorders were more than usually prevalent (probably due to the effects of the inhaled tobacco dust and perhaps its absorption through the skin of the hands and fingers). Investigators reported the following instances of *industrial diseases* which they observed while on their visits of inspection: acute tobaccoism, 2 cases; tuberculosis, 2 cases; and irregular heart beat in numbers of persons. *Comments.* — It is to be hoped that this more or less drudgery class of work will be eventually successfully superceded by machine methods for the good of the health of the workers concerned. In the meantime every effort should be made to curtail the monotony, to overcome the inactivity, to promote ventilation by artificial means, and to supervise the health of the individual workers.

TOBACCO. — CIGAR BUNCHING AND ROLLING.

This process consists in "bunch breaking" the tobacco by one set of workers and "rolling" the bunches into cigars or stogies by another set who apply the binders and wrappers. From a health point of view, both processes were similar.

The process was investigated in 20 plants located in 6 cities and employing a total of 3,209 wage-earners, of whom 669 were males and 2,540 were females. A small amount of mechanical assistance (canvass and rollers in bunching and a suction system in rolling) was found present in a number of places, but, outside of this, the work was practically all hand manipulated. Workers were usually seated close together, in front of little desks arranged in long rows, so that their elbows nearly touched side by side and their feet nearly touched those opposite them.

Unions existed in 2 of the places investigated (here men made the entire cigar, did their own bunch breaking, rolling, selecting and packing). The general attitude of the employers toward the help in this process appeared good in at least 18 of the 20 places, while the type of employes was good in 15 and largely an ignorant class, usually foreigners, in the remaining 5. The workers were semi-skilled and dexterity had made them quite adept. A large class of girls made up this group of workers, while in some instances their mothers were engaged in the tobacco stemming and stripping department. Endeavors were apparently made at all places to retain the same help although in 4 places

the personel appeared to change considerably, according to statements made. Where the suction systems were present, these acted in a manner as health appliances, but, outside of this, other arrangements for conserving the health of the workers were generally absent, although in 5 places sanitary conveniences and natural means of ventilation were good. Restaurants were present in some places. In 3 places some attention was given to instructions upon personal hygiene. There were no sick benefit organizations. The general construction of workrooms was good from a hygienic viewpoint in 8 places, fair in 2 others, but poor in the remaining 10. In 8 places workers in the various sub-processes were all on the same floor and in the same room, while occasionally other processes such as Stripping, were also present. Age-group estimations for these workers summed up as follows:

Age-groups.	*No. Wage-earners.*
Over 50 years	13
45 to 50 years	52
40 to 45 years	169
Under 40 years	2,975
Total	3,209

About 25 per cent of the latter group were under 20 years of age.

Dust, consisting of tobacco disintergrations was present to a small amount in all places, but only in a few, where general *cleanliness* and order were not maintained, was it much of a health-hazard. In some places old and rough floors made cleaning difficult. *Light* was poor in these quarters in 5 of the 20 places, particularly for workers on the interior parts of large rooms. Most places resorted to white-washing or light painting once a year to aid in lighting. In some large plants most of the work was done under gas light. The *ventilation* was good in 4 places, fair in 12, and bad in the remaining 4. Close, stuffy workrooms filled with large numbers of persons (sometimes hundreds in the same room) and no means of overcoming the stagnation of the atmosphere was the principal reason for air vitiation. Many of the quarters appeared very close upon first entering them, although the condition was probably not noticed to any extent by the busy workers engaged within. *Fatigue* was also a chief hazard in this process. The chief reasons arranged in descending order were, hurrying piece-work, monotonous reduplication of the selfsame movements, stooped over, sitting postures, and the evident tension under which persons were engaged. In addition, boxes were the only seats furnished in some places, while chairs without back rests were more often the rule than otherwise. The workday was difficult to determine in some places (see stripping), but the following was about the average: 8 hours in 5 places, 9 hours in 9 places, and 10 hours in the remaining 6. The noon recess was 1 hour for these workers in 10 places, (insisted upon in several large places), about ¾ in 3 places, and ½ hour or less in the remaining 7. Other recess periods were observed in some places, but this was more or less left to the individual's preference. Some plants did not work Saturday afternoon, others worked until 3 p. m., others worked throughout. *Inactivity* was as much of a health-hazard as fatigue, due to the sedentary character of the work. This was circumvented in a number of places by requiring the employes to get up and get

their own supplies and to deliver the work which they had finished. In but 2 places had enough thought been given to the subject of fatigue and inactivity to enable investigators to grade these two features as negligible. The liability to contracting *communicable diseases* was marked in some 15 plants, due, especially, to close crowding together of large numbers of workers irrespective of the amount of room space in the quarters. Thus, it was common to find a hundred or more girls all bunched together in a third of the room which was not any too large to safely accommodate them all, were they spread out to cover the space. Other features were about as already described under the head of Stripping. In this work also tobacco was more frequently handled by different persons at short intervals than in probably any other process. Biting of the ends of the cigars and moistening the wrappers in the mouth was a common observation, although signs were often present forbidding it. It was said that it was impossible to break old workers of the habit, but new ones were not allowed to acquire this habit. There was no evidence of efficient medical supervision in any of the places investigated, so that, as stated elsewhere, consumptive persons or others with commuicable diseases might be present for long periods in the midst of the other workers. In this connection it is well to call attention to the vital statistics mentioned under the heading of Tobacco Manufacturing in Part IV. The hazard of *poisoning* from tobacco was the same as elsewhere in this industry — the workers were constantly handling the tobacco, a fine dust was present, tobacco vapors filled the air, while those who did biting and lip moistening got the juices. The adhesive was gum tragacanth and licorice. Workers' faces were often very close to the work, particularly in the case of shortsighted workers. The industrial inducement to *stimulantism* seemed negligible in 3 places, but in all of the balance there was a considerable incentive to the same because of the depressing influences of such hazards as fatigue, inactivity, tobacco dust, juice and odor, and unventilated working rooms. The general *appearance* of the workers in this division of the industry was somewhat better than in most of the other processes, principally because a large majority was young persons, although many unhealthy looking individuals were seen. Many were seen to wear eyeshades. Shortsightedness was also common. The chief *complaints* of the workers were fatigue, nausea, loss of appetite, dyspepsia, and other digestive disturbances, headaches, dizziness, nervousness, palpitation, and a higher rate of female complaints than the average (particularly menorrhagia). Workers and officials also stated that they were bothered a great deal worse on first entering the work than later, showing that they were living in a state of toleration (see discussion in Parts II. and III.). It was said that numbers of new employes never came back after the first day, and that in other places sickness was so common that very few averaged a month of steady work on account of the same. A number of workers also complained of tobacco dust as irritating the nose and eyes. While our investigators interviewed a very small number of persons they reported the following instances which were very probably *occupational* in character: tuberculosis, 4 cases; "tobacco heart", several cases; myopia, several cases. *Comments.* — In view of the high death rate from consumption among this class of workers everything possible should be done to mitigate against the hazards above mentioned, all of which are more or less predisposing to this disease. Unquestionably new employes should be accepted only after a physical examination and all cases of

sickness should be investigated by a physician to determine to what extent any of the various hazards may have been responsible in whole or in part for the illness. Particularly, should means be taken to artificially ventilate this class of workrooms where such large numbers are employed for hours at a time. If this process could be done out-of-doors, there would be a very different tale to tell in listing the types of sickness and the ultimate causes of death. Lip moistening of the ends of cigars should be discouraged more because of its affecting the health of the worker rather than danger to smokers afterward, since the interval elapsing between the manufacture and sale of the cigars is much more than an hour or so in most cases (which is probably the longest period that any infectious agent could survive the natural drying effects of the air).

TOBACCO. — MISCELLANEOUS PROCESSES.

CLEANING, CASING, DIPPING AND WRINGING. — Tobacco was dumped from boxes onto the floor, where men shook it up with pitchforks, and girls picked out the stems. A great deal of dust was created, but the process was found to be well taken care of with efficient hoods in 2 large places. The tobacco leaf was then forked onto endless belts which ran through steam chambers, which cleaned and "cased" it. From here the tobacco went to the dipping machines where it passed through a flavoring solution. It next passed through wringers which removed the excess "dip". In these latter wet processes, quarters were well taken care of and no hazards outside of the odor, vapors, and handling of tobacco appeared present.

COOKING AND MIXING DIP FOR TOBACCO. — This work was done by men and was a continuous process, the twenty-four hours being divided into two long shifts. The dip consisted of a solution of licorice, glycerine, sugar, rum and alcohol. The steam from kettles was all removed by hoods and exhausts. There appeared to be no hazard.

TOBACCO ORDERING. — This consisted in the rehandling and adding flavoring preparations to tobacco which was not yet up to the standard. It was found to employ a small number of men.

TOBACCO SIZING OR SORTING. — The sorting of tobacco leaves is a common process in the industry, and employed a considerable number of persons of both sexes. Constant standing was the rule. The work was monotonous, and complaints of indigestion, palpitation and headache were quite common. Many of the girls so employed complained of nervousness and a few were anemic. They were affected most during the first few days of work.

SIEVING. — To remove dirt, pebbles, etc., from cheaper grades of tobacco, it was subjected to shaking and sieving processes in a boxed-up machine. The work was done only a few times a week even in large plants, but was very dusty.

SWEATING. — Tobacco was subjected to hot moistening processes in closely confined rooms where the heat was considerable, and ammonia fumes were plainly detectable. Workers were only required to be in here a short time.

PLUG TOBACCO PRESSING. — This was a machine process, along with applying the tin foil, tags, boxing and nailing. There appeared to be no health-hazard present. Piece-work was the rule.

MIXING.—Mixing of chewing and smoking tobacco employed about an even number of both sexes, and was very dusty. The girls stood up as well as the men. There were many anemic looking ones among them.

PACKING CHEWING AND SMOKING TOBACCO.—This employed a large number of girls and a few men. Standing was the rule. The chairs provided were without backs and were few in number. The work was piece-work. Ventilation and light were not good in the places investigated. Many of the girls were anemic, very nervous, and were unable to work steadily. New workers were usually sick in the first few days, while one official said there was no question that numbers of the girls were tobacco poisoned. A neighborhood physician in 1 place commented upon the number of heart cases (tobacco hearts), female disorders, and anemia which he had treated among tobacco packers. It was also his observation that they stood anaesthetics very poorly in case of surgical operations. It was found that the girls were handling moist tobacco, their hands were stained with the same, and that probably absorption from the skin took place.

TOBACCO MACHINE PROCESSES.—Besides the making of plug tobacco, the weighing, sacking, putting in paper covers and tin foil, tagging and labeling, was done largely by machinery. It employed a large number of workers, about 4/5 of whom were females. As with most routine machine work, it was monotonous piece-work. Most of the workers stood up, and such seats as were furnished seldom had backs. Workers were also crowded together, irrespective of the general room space in 2 places, while natural light was poor. In 1 place, however, the general ventilation of quarters was excellent, due to the installation of blower systems and exhausts.

PACKING CIGARS.—This is done mostly by men, although in 1 place women were employed at it exclusively. Good daylight was required, since it was necessary to select the different shades, shapes and sizes very carefully. This was the most skilled process in the tobacco industry, and the workers were well paid. Hazards were: constant standing, piece-work, eye-strain, handling tin foil (always a danger of its containing lead), and the odors and vapors from tobacco, as well as the handling of the same. Complaints were few, but consisted of headache, dyspepsia, and other forms of indigestion, a part of which may have been due to leaning again the work tables with the stomach.

BANDING, BRANDING, AND LABELING CIGARS.—This work was done usually by young girls. It was day work on fine cigars, but piece-work on other qualities. Many of them put the labels to their lips to moisten them. They also handled tin foil. (See also Gluing, Pasting and Labeling.)

SALT.

The one salt works investigated employed about 150 wage-earners at the time of our investigator's visit, of whom all but 15 were males. The females were engaged solely in packing. The workers were of a fairly intelligent type and appeared to be kept fairly steadily at the plant. There were no efforts made along the lines of health conservation in relation to the work, no health placards, lockers or change rooms, while washing facilities were exceedinly meager, and toilets only fair. There were a few hoods over some processes. The workday was divided into two shifts of 12 hours each for all except a

few of the general labor, and the females. The process workers were divided as follows: open evaporation, 3; vacuum evaporation, 2; drying, 2; packing, 15 men and 15 women; while the balance were general laborers, coopers, etc.

The plant was composed of several buildings and covered much ground. In the open evaporating process *humidity* was considerable from steam off of the pans, while the hoods present were not efficient. At times one could hardly see across the room. One worker complained of frequent *colds* during winter. In the vacuum drying process there was considerable *heat,* the effect of which was more. marked since the men were constantly exposed during a 12-hour shift. Packing was done by girls, largely, who worked piece-work, and were on their feet practically all day. The dry process, where the salt was died by hot air over a revolving cylinder, was also pretty warm, although workers were only occasionally exposed. *Comments.*—There was no exposure to poisons so far as could be ascertained. It should be mentioned that those who grind and pack salt are subject to perforation of the nasal septum, due to the irritation of fine salt dust upon the mucous membrane. Nose-bleed is a warning sign. This condition has been reported among the workers at St. Clair, Michigan.

BROOM MAKING.

The making of brooms and brushes was investigated in 10 establishments in the state employing a total of 86 wage-earners, of whom all but 4 were men. These four (girls) did sorting of broom straws. The largest plant seen employed but 13 persons. There were no unions. The general attitude toward employes appeared quite indifferent in about half of the plants, although the retention at the trade and the type of workers was good in a total of 8 places. The trade was said to be dull "winter and summer" in some places. In 5 places health appliances, consisting of hoods and blower systems over the seed stripping machines, were present and quite efficient in 4 of them. The work was largely of skilled nature. The age-group estimations summed up to show that there were 40 (or a little over half) over 40 years of age, and only 4 under 20. Work quarters were hygienically constructed in 3 places, fairly so in another, and not so in the remaining 6. Often lofts or barn-like structures were used which were very imperfectly heated in the winter season. In half of the places the various processes of stripping, bleaching, sorting, dyeing, and millwork were all carried on in the same room.

Broom corn *dust* in the breathing atmosphere was bad in 4 places, fairly so in another, but quite negligible in the remaining 5. Only 3 places were *cleaned* up and swept daily. The others were very dirty. Quarters were not well *lighted* in 4 of the 10 places, but general room *ventilation* appeared good in all except 1 place. The open structure of the sheds in which the work was done in most places made ventilation good. *Fatigue* was the principal hazard in the process and was considered bad in 3 places, and fairly so in all the remaining. The chief features were hurrying piece-work, monotonous application, constant standing, speeding up, long hours, more or less constant strain, faulty postures, jarring pocesses upon machines, and, for some, pressure against the person and loud noises. The workday was 8½ hours in 2 places, 9 to 10 hous in 6 places, and 12 hours in the remaining 2, while the noon recess was only ½ hour in 8 places. The next hazard was the liability to contracting *communicable diseases* which was present in all places, and was bad in half of them. The reasons for this were the tendency to crowd workers

together, the use of common towels and drinking cups, of very poor or absent wash-places and toilets, spitting upon the floors, the absence of cuspidors, and the risks from cuts and injuries to the eyes and from flying particles. There was, of course, no medical supervision in these small plants. The *poisons* used were found to be sulphur dioxide and chlorine used in bleaching processes, with little risk. A weak solution of anilin dye was used for staining, and appeared harmless. The industrial inducement to *alcoholism* was influenced by the fatigue factor, the dust and the uninviting surroundings. Beer was "allowed A. M. and P. M." in 1 place.

The general *appearance* of workers was good in 6 places, while in the remaining, 1 or more pale and anemic persons were seen. The workers had no *complaints* to make (as is the rule in most small places which are more or less mutually managed). *Comments.*—The hazards above named suggest their own corrections. In 1 place, wetting of the broom corn the night before greatly decreased the dust. In 1 of the worst places a consumptive was employed for extra help because he was only able to work part of the time!

STREET CLEANING.

At about six o'clock one evening two of our investigators came upon a group of 10 or 12 men in one of our large cities, busily engaged in sweeping with push brooms on a principal street. They were without any protection from the dust, either through previous sprinkling of the thoroughfare, or by the wearing of respirators. Also pedestrians, open windows and doors in the vicinity, and the occupants and contents of buildings had no protection from the immense clouds of dust which were raised. This is a travesty upon society's care of itself, and serves to show that while there is agitation for employers and employes to improve conditions of industrial and personal hygiene, the public administration permits wanton violations of the first principles of hygiene. It is needless to say that for workers as well as "innocent bystanders" such primitive methods of street cleaning should be dispensed with.

DINING CARS.

During the course of the survey, investigation was made of 4 railway dining car kitchens. Arrangements in cars of three different makes were practically the same. The chief hazard was the exposure to *extreme heat.* This seemed to be as marked as that for furnacemen or mill hands in an iron and steel works, particularly in the warmer seasons of the year. There were 3 men employed in the kitchen, including the chief cook and 2 helpers, and one in the butler's pantry, the latter located between the kitchen and the dining quarters. Serving windows connected this pantry with the kitchen, and while the train was in motion, a considerable amount of heat from the kitchen passed through into this pantry. Various warming ovens also added to the temperature. This worker, however, was usually not nearly so much exposed to the temperature hazard as those in the kitchen. In all of these cars there were exhaust fans located in the ventilators in the side of the roof. In 2 instances they were not operating, although the weather was very warm. One was out of order, while it was said in the other case that it had been taken out for repairs at some considerable time before and not returned. Some of the kitchens had two of these suction fans, the others only one. When present,

they unquestionably helped materially by promoting ventilation and sucking out the heated air. The motion of the train also assisted in this.

The *temperature* is favored by a number of factors. First, there are the hot stoves and ovens extending along one side of the narrow kitchen for a distance of about 12 feet, and heated by coal, coke or charcoal. These are equipped with heat confining hoods which come down about to the level of the head or a little lower. Up beneath the hoods are located shelves and cabinets for warming purposes. Second, the space between the stoves and the sinks, tables and cabinets opposite is so narrow (only a matter of about 3 feet) that the 3 men are kept very close to the main source of heat. Third, the roof overhead is practically full of obstructive piping and two long horizontal tanks, one containing hot water, which was not covered with insulation or other protective covering and consequently helps to add in the heating of the quarters. The other is the cold water tank which, however, from its close proximity to the other tank, and location over the ovens, usually gets hot and further helps to radiate heat. Fourth, where the road-beds are at all dusty, it is necessary to keep the windows practically closed, and, on account of railroad smoke, the same applies to the narrow window ventilators in the roof. It was also stated that orders were issued prohibiting the opening of the door into the vestibule, this due to several reasons such as the liability of passengers to mistake the entrance into the kitchen for the entrance into the dining car, the desire for privacy for the workers, the liability of theft, etc. In one instance this door contained a screened window which helped a little in promoting ventilation, but it was too small and placed too high (on a level with the head). Otherwise, the vestibule was closed up solidly. Fifth, the window spaces (on one side only) when open, were so small, narrow and high placed that they could admit but very little air, and the screen meshing used was so fine that this also hindered greatly. It was also pointed out that in the case of a wreck these men were likely to be caught in quarters from which they could not escape because of the jamming of the only doorway present, and the fact that the window openings were too small for a man to get out of, at least until the sashes could be shattered to enlarge the openings. Sixth, a "turn" in the kitchen required from two to four hours, according to the number of dining car "calls", and the number of passengers to be served. During this time all workers were constantly busy, and usually in considerable hurry so that respites were few. Seventh, workers were under orders not to leave kitchens during these "turns". — It can be seen from the above that all of these factors combined to render the exposure to high temperature in a crowded and air-stagnant space very great. Workers (both colored and white) made great *complaint* of the heat, which, in addition to profuse perspiration (which was literally pouring from all of them), caused suffusion and heat dermatitis of the face and the skin of the arms, and blood-shot eyes, and unquestionably affected the eyesight, particularly of the chief cook who necessarily had his face toward the ovens the greater part of the time. Wearing of protecting glasses was impracticable because of soiling with perspiraiton, smoke and steam. In one kitchen a thermometer which the investigator carried registered 135°, at the level of the head and in the position which the cook occupied. Perspiration also dropped constantly from arms, face and head upon whatever was below, oftentimes including the food being prepared. The impossibility of taking a

bath after each "turn" and the wearing of sweaty underclothes out into the draft afterwards were both arch health-hazards.

Comments.—While heat is a necessary function of cooking, and somewhat of the kitchen itself, it seems that the condition is about as extreme in dining cars as in any process investigated. Unquestionably, permission should be given to open doorways, while, in addition to exhaust fans (more of them and placed in unmolested sites), two or three blow fans should be placed in the corners of the kitchen to whip up the atmosphere and promote evaporation from the surface of the skin. It would appear that a ventilating engineer could devise means to more effectively control this situation.

LIME BURNING.

The process of manufacturing lime or "lime burning" was investigated in 7 establishments located in 6 different communities in the state and employing a total of 188 workers at this process alone. The balance of help was variously engaged in the quarries, Gas Production plants, cooperage, etc. There were no unions among the workers, while the work was very largely of unskilled nature. A fairly large percentage of foreigners and some negroes were found employed. The majority of the workers were of a changing character. In only one place was a blower system present to limit the amount of dust. To kiln men there was considerable danger from inhaling carbonic acid gas as well as some sulphur fumes. A very risky feature was that of the workman's on top of the kiln getting down into same to attach cables to cars, accidentally fallen in. Some workers tried to prevent sore feet due to the lime by buying high shoes and tieing the pant legs about them.

The following is taken from the special report of the investigator who visited 6 of the 7 plants.

"I. *Quarrying.* This was not inspected, but work is done in same way as any quarry, except no attempt is made to save large stones. Health-hazards same as elsewhere.

"2. *Loading Kilns.* The stone is placed in a car on a track and drawn by cable operated from top of kiln platform. The kilns are open and CO_2 constantly escape. One man usually, but sometimes two, attend to the drawing and dumping of cars. CO_2 fumes called "dead gas" in kiln talk sometimes affect the men on top if wind blows toward them. Of course one big advantage is that they are in the open. Should be two men always in case one should be overcome. Could not, however, find any place where asphyxiation had occurred.

"3. *Drawing* or *Unloading* the Kilns. The limestone ($CaCO_3$) after sufficient burning is converted into lime (CaO) and taken out from the false bottom of kiln. There are several ways of doing this. Some kilns have a "scissors opening" with short handles; others are opened from a platform above, and still others are opened from below, but man stands 10 to 15 ft. from bottom. The lime is dropped from kiln into wheelbarrows or carts. Health-hazard—dust raised when lime drops from kiln. Man gets most with "scissors" type, which necessitates his being close to dust. Some places are bad because wind may blow from side opposite man and give him all the dust. In one large plant the men had placed old pieces of tin or sheet iron over the opposite side of the pit.

No goggles. No respirators, the rule. Heat — not much hazard in most places.

"4. *Grinding and Packing.* This is done in all plants, but is, of course, aside from lime manufacture. The lumps of lime after cooling on a floor space are taken to mill and ground to powder. This is then sacked by machinery. Health-hazard — dust is very bad. Air is dense in some places. In only one place was there an efficient suction system, and here president of company stated that the saving of lime collected paid very good interest on the money invested in blower system. Skin irritations, especially in summer, and frequent eye inflammations complained of. Goggles were furnished but few worn; respirators also furnished but none worn. Few men used handkerchiefs over mouths.

"*Worst features:*

1. Ignorant foreigners, the rule.
2. No wash places.
3. Poor outside toilets.
4. No health appliances except in one plant.
5. General "Don't Care" attitude of those in authority in most places.
6. The general idea prevails that lime dust (that is, CaO) is a good thing to inhale! In some communities certain M. D.'s were quoted to this effect. Many plants had men who were decidedly pale and a few short of breath only since entering plant.
7. Skin and eye irritation very common. Much worse in the summer time.

"*Addenda.* — Two plants visited used coal to burn lime while others made gas with producers, — the usual poke-hole type. To soften lime or keep down heat, steam is usually injected upon the limestone. Another process associated is the removal of soot from kiln which may be needed at certain intervals. This is a very dusty process and is usually done by steam."

The workday was 10 hours in 6 plants and 12 hours in 1, the noon recess being 1 hour in 3 places, ½ hour in another, and "no regular" in the remaining 3. Night shift work was the rule in 3 plants. The industrial inducement to *alcoholism* was considerable in all places, due to the breathing of lime dust and the depressing influences recited above. In some places the men lived in shacks behind kilns. It was said that men remained the shortest time at the loading process. *Comments.* — It would appear that if an exhaust system were so efficient for a certain work in one plant, the same should be installed for similar work in all the plants. It is quite evident also that considerable attention should be given to finding means toward cutting down the other health hazards mentioned. Particularly would we emphasize good washing facilities, including the construction of a simple type of shower bath.

CEMENT.

Cement manufacturing and mixing was investigated in 2 plants employing a total of 98 men. The work was found to be very dusty and dirty and the quarters in one place very seldom cleaned. The *dust* was composed of

cement, lime, silica, and powdered coal, and there was practically no method of controlling it. *Heat* was intense for some of the workers, and there was practically no protection against it. *Hours* were also very long (12 hours per day). There was great opportunity for contracting *communicable diseases* because of promiscuous spitting, absence of cuspidors, poor closet facilities, and the dust flying about. It was noted that the cement dust tended to cake in the nose, and the superintendent in one plant said this kept it out of the lungs! The pulverizing of coal so filled he air with dust in 1 place that the workmen could hardly be seen. About the same conditions existed in the dry grinding of the cement and in the sacking department. Our investigator stated that he had never seen so much dust flying around in any plant. The vegetation in the neighborhood was covered likewise with powdered cement. It seemed to be the belief among the officials and workers (as was also stated for lime) that this dust was healthy to breathe! There were no change rooms, showers, lockers, or eating places for the employes, while washing facilities were practically absent in both places, and toilets very primitive.

BRICK AND TILE. — GRINDING AND MIXING.

The grinding and mixing of clay for the manufacture of brick and sewer pipe (tile), was investigated in connection with 9 establishments, in 7 city communities, where 67 workers were found employed at this process. In all cases the clays were obtained from a pit at or near the works, and conveyed by small cars to the mixing and grinding quarters.

This part of the work was done in openly constructed buildings in small places, but inside in larger plants. There were no unions. A fairly intelligent type of employes was engaged in all except two large plants where few could speak English. Their steadiness at the work varied greatly. In all places the work was quite limited to the open season. In 2 instances, health appliances, such as cool-air blowers and boxed-in chutes were present, the latter greatly limiting the dust. In fact, in one of these places the air was free of dust and the quarters were as clean as any well kept factory. Five of the total number of workers were over 40 years of age.

The chief objectionable features to this process, from a health point of view, were the breathing of clay *dust*, and the red coloring compound often mixed with it, the *dirt* under foot, the *dampness*, and, for cooler weather, the absence of heating arrangements, all of which were fair to bad hazards. In 2 places, the work was housed-in so that the *light* was poor, and a similar condition existed for *ventilation* in 2 places. In 1 place the mixing machine was so close to a kiln that workers were affected by the heat. In all places there was a moderate risk of over-*fatigue,* not so much from laborous work, which was not the rule, but from monotonous application, constant standing, and the loud noise from the grinding machine. The workday was 10 hours in all except 1 place, where workers usually quit at the end of about 9 hours. In some places a unit production was aimed at, and this determined the workday. The noon recess was 1 hour in 3 places, ¾ hour in 1, and ½ hour or "as desired" in the remainder. The liability to contracting *communicable diseases* was bad in all places, except 1, due to promiscuous spitting into the dried-up clay dust under foot, the absence of cuspidors, the absence of washing facilities (at all places, large and small), and the very primitive closet arrangements in

small places. However, the out-door character of the work in most places mitigated against this hazard. The risk of contracting *hookworm disease* was considerable in all of these places, due to the primitiveness of sanitary arrangements, both here and at the clay banks, and the liability that a person with the disease might secure employment and infect the soil. The industrial inducement to *alcoholism* was considerable in most instances, due to the dusty and sloppy character of the work, and, in several instances, the uninviting character of the drinking water supply.

The general *appearances* of these workers as to health were good in about 3/5 of instances, while none were seen who were decidedly sickly appearing. The dust and dampness, and inability to keep clean were the only comments made by the workers themselves. *Comments.* — These workers, as well as the rest of those in brick and tile works, should be provided with proper toilets, washing places, and drinking facilities, because of the risk of typhoid fever, as well as hookworm disease. Workers predisposed to lung troubles should not engage in any part of the brick industry. For certain intervals of very dusty work, the workers should put on respirators. There should be present good first-aid equipments for minor injuries as well as major accidents. Grinding and mixing processes everywhere could be rendered entirely dustless for the places in which the workers are required to remain, as was seen at one plant.

BRICK AND TILE. — PRESS ROOMS.

From the grinding and mixing machines the clay passes directly into the presses, as a rule, where the brick or tile pipe (usually) are made mechanically.

The pressing process was investigated in 9 establishments in 7 communities, and employed 200 men (including 5 moulders, and 4 "branch men" in two sewer pipe establishments). There were no unions. The employers' interest in employes' welfare seemed good in 5 places, but quite indifferent in the remaining 4. The general type of workers ranged as described under Grinding and Mixing. In one large place it was said that only half of the men remained steadily, and that the remainder changed almost weekly. In 2 places health appliances existed, such as cool-air blasts and some attempts to limit the dust. In other places the dust and dirt accumulated until it obstructed locomotion before it was removed. The work quarters were not constructed from a hygienic viewpoint in any but one of the plants. In several places old sheds or barns were used. There were no wash-places anywhere, and no toilets of any kind in 3 places. Two other places had good inside toilets. The work was unskilled. Age-group estimations summed up as follows: over 50 years, 1; between 40 and 50 years, 35; under 40 years, 164. About 5% of the latter were under 20 years.

Dust, from the drying of wet clays under foot, principally, was a bad feature in 3 places and fairly so in 3 others, while in 2 places it was negligible. in one large place it was so thick in the air that one could see scarcely 30 feet. There was not enough care given to *cleanliness* of quarters in 8 of the plants. In 6 of the 9 places the work was *damp* enough to be a hazard, and workers were unable to keep dry, especially with the forms of footwear and clothing used. Quarters were not well *lighted* in 2 instances. *Ventilation* was very poor in 1 place, and not good in 1 other, due to confined quarters. The work was apt to be cold and chilling during certain seasons, because of the

absence of any *heating* arrangements. In 6 places there seemed to be a number of factors productive of *fatigue*. In descending order these were as follows: constant standing at monotonous work in faulty postures; hurrying piece-work with evidences in some places of speeding up; and loud noises. The hours also were pretty long for steady application. The workday was about 10 hours in all places, but was usually regulated by the unit of work it was desired to turn out during the day. Occasionally, by extra effort and no mishaps to machinery, the workers were finished by three or four o'clock in the afternoon. A noon recess of 1 hour was taken in 3 places, but in the remaining it varied considerably, and apparently no regular time was observed in some places, the attention being set on getting the day's work finished as soon as possible. The liability to contracting *communicable diseases* was greater than in the grinding and mixing quarters and due to the same causes and the presence of a greater number of persons in closer contact. The industrial inducement to *alcoholism* was considerable in all places, due to the same features as mentioned under Grinding and Mixing. In but 2 places was a safe drinking water supply at hand, and here common cups were in use. .In many instances the men actually believed that the breathing of clay dust was healthful!

The same features concerning *complaints* and *comments* obtained as given under Grinding and Mixing.

BRICK AND TILE. — KILNS.

In 9 establishments visited in 7 different communities there were 116 men employed in setting, firing and drawing the kilns of brick and sewer pipe works. In 4 of the establishments temporary kilns were built about each pile of bricks. The 2 sewer pipe works had permanent kilns. There were no unions in connection with this process, while the general type of workers, their retention and steadiness did not differ from those at other processes. There were no appliances which could be considered as having to do with the conservation of health, nor were there any instructions or placards in this direction, nor sick benefit associations. The work was unskilled. Usually, kilns were entirely by themselves, although workers sometimes interchanged to other processes. Age-group estimations for the kiln men showed 14 over 40 years, and 102 under that age.

The chief hazards of this process were exposure to *heat,* alternating with weather conditions. This seemed bad in 3 places, and some hazard in all of the remaining. It depended somewhat upon the methods of drawing the kilns. In some places workmen were put upon them while temperature was yet extremely hot. In one place premises around the kilns were kept very neat and *clean*. As elsewhere in this industry, *fatigue* factors were present, and probably more so in this process than any other. Arranged in descending order, as nearly as possible, these were: monotonous application, with constant standing for long periods, hurrying piece-work, with evidence of speeding up; laborious work under considerable strain; pressure against the body, and long hours. The workday was 10 hours in 1 place, and from this to 11 and 12 in others, particularly at times. All burners worked in two 12-hour shifts. The noon recess was often not observed, at least at any regular period, but as workers desired they took time off to eat. This was so in 6 of the 8 places. The liability to contracting *communicable diseases* was bad in all places, although

the risk of contracting *hookworm disease* seemed less than for other workers. The causes for the other risks were the same as described under Grinding and Mixing. There was some danger of *poisoning* from the inhalation of kiln gases when kilns were entered before they were sufficiently cooled and time allowed for gases to escape. There was no evidence, however, of person's having become asphyxiated in this manner, but the possibility of chronic poisoning was present. All glazing was done by the addition of salt and not lead compounds. The industrial inducement to *alcoholism* was considerable for most of the workers, and was incited chiefly by the fatigue hazard, long hours, hot, dirty work, often poor drinking water facilities, and absence of washing and bathing arrangements.

The appearance of workers was generally good in most places, while in some others one or more were seen who complained of their health, or appeared decidedly under good physical condition. *Comments.* — This is a process requiring hard, laborious work, at intervals, but this should not proclaim it necessarily unhealthful, provided the many other features above mentioned were not present to menace the health of the workers.

FILE CUTTING.

The manufacture of files was investigated in 4 establishments in which 108 wage-earners, all males, were found employed at the process. The number of employes ranged from 7 to 54 in each establishment. Some machine cutting of files was done in 2 establishments. The general attitude of employers toward employes appeared good in all places, while a large percentage of the workers were skilled men who remained well at the respective places of employment. There were no special devices which could be designated as health appliances in any of the plants, even the forges in a large plant being without hoods and vents. The general construction of work quarters was good in 1 place, fair in another, and hygienically bad in the remaining 2. In the smaller places there was an intermixing of various sub-processes, as forging, grinding, tempering, and cutting. Age-group estimations summed up as follows: over 50 years, 10; from 40 to 50 years, 13; under 40 years, 85. Of the last group about 5 per cent were under 20 years.

Dust was a hazard to grinders in all places, although the principal work was done in the wet on large grindstones. The friction heat present, however, with the flying of sparks, caused a certain amount of fine dust to escape, in spite of the water. There were a number of unprotected emery wheels. Polishing was also done by sand blasts. A small but constant amount of dust was also produced during cutting which always contained some lead scraped loose from the "bed" which supported the file. Workers' faces were also quite close to the work. None of the places visited were exemplary in matters of *cleanliness* and order, while in 3 there was plenty of dirt and waste accumulations. A dirt floor was present in 1 place located in basement-like quarters. *Dampness* was a feature of the work in the grinding rooms, where the water occasionally escaped from the grindstones and soaked up the floors. The *lighting* of quarters was good in 2 places and poor in the other 2, in 1 of which oil lamps were depended upon for the principal illumination. The general *ventilation* of quarters was fair to good. The ceilings in one place were scarcely 7 feet high. Contaminations existed from heating ovens,

forge gases, tempering pots and annealing furnaces, and from crude heating arrangements in 2 places. The question of *fatigue* is not debatable, at least for the skilled workers. There is an unusual amount of reduplication of the same movements and monotony in the hand-cutting process (from continuous mallet and chisel work) and, also in grinding, with the assumption of awkward, stooped postures in both processes, and pressure against the body. It is estimated that the cutter strikes 45,000 blows a day in turning out his quota of files. In 1 plant practically all work was piece-work, while noise was excessive from trip-hammers. The workday was 9 hours in the smallest place and 10 hours in the other 3, with ½ hour for a noon recess. The liability to the contraction of *communicable diseases* was considerable in all places, due to the use of common drinking cups, promiscuous spitting upon the floors and into dust and dirt accumulations, the absence of washing facilities in 2 places, poor toilet arrangements, and the presence of dust and dirt from the processes. The liability to industrial *poisoning* was considerable for the hand-cutters where soft lead plates were used beneath the files worked upon, due to the creation of a fine dust, and to the lack of personal care in keeping the soiled fingers away from the lips. Again, in the lead tempering process (part of tempering was done by heating in charcoal and coke and then immersing in brine), there were the same hazards as described under this process elsewhere. Chronic or slow lead poisoning is the form of the disease most likely to be present, although the personal factor of carelessness might produce acute poisoning in a short space of time. The absence or inadequacy of washing facilities is, of course, a most important feature in poisoning. The inducement to industrial *alcoholism* would appear to have three factors: the irritation of the respiratory passages from the fine hot dust from grinding, the slow ingestion of particles of lead, and in some places the dirty and unkempt surroundings.

The general *appearance* of workers was fair in all places; some, however, appeared prematurely aged, while a considerable number had pyorrhea (or diseased gums) along with decayed teeth. As a rule, the men were quite satisfied with the conditions of work, although some *complaints* were made of "rheumatism", stiff wrists, while 1 man said he had seen several cases of wrist palsy. These were undoubtedly due to lead poisoning or an occupation-neurosis from hammering. In another place, 3 out of 4 file cutters had attacks of so-called "typhoid fever" which were probably lead poisoning, from the symptoms described. Some workers complained of eye-strain, and 1 showed a bilateral blepharitis (inflammation of the margins of the eyelids) which was due to the close eye-work required in both grinding and cutting in poorly lighted quarters. Investigators discovered 2 cases of lead poisoning, 1 of which occurred in a lead temperer.

Comments. — Placards of instructions to employes upon "How to Prevent Lead Poisoning" should be posted in all file works, hoods should be over forges and lead baths, considerable attention should be given to lighting, while every convenience in the way of washing facilities and a place to eat, safe from the danger of lead poisoning, should be provided. In some places there appeared to be an unnecessary exposure to dust from grinding processes, which apparently could have been easily equipped with a blower system. There was also considerable dangerous machinery, pulleys and unprotected belting in some places. Sir Thomas Oliver (Great Britain) states that

"the death-rate of the cutters from pulmonary phthisis (consumption) and lead poisoning exceeds the mortality standard of ordinary occupied males by 90 per cent., and after 35 years of age it is still higher." File cutting by machinery removes part of the hazards.

IRON, STEEL AND WIRE. — GENERAL STATEMENT.

The manufacture of iron and steel products from the point of view of health-hazards is practically the same as Furnacing, Iron Founding, Machine Shopping, and General Factory Processes, all of them, however, upon a gigantic scale. The hazards are the same in type, but may be greater in degree. This latter factor depends largely upon whether the works are of modern building construction and the processes mechanical and automatic, or whether they are collections of crowded, low roofed structures in which hand methods prevail. It may be said that because of competition the adoption of mechanical appliances has been necessary to a large extent in most of the plants which are to-day doing business. However, here and there, even in the larger works, hand methods in health-hazardous operations have not been fully substituted by mechanical devices where they might be. A very much smaller number of wage-earners, however, are exposed to these hazards than was the condition some years ago.

It is not proposed to go into the various processes of this industry in any detail whatever. This has been efficiently covered for Ohio as well as other states in the "Report on Conditions of Employment in the Iron and Steel Industry in the United States," Senate Document No. 110, 62d Cong., 1st Sess. (1913), and particularly Volume III. of this report. In the same volume, pages 510-532 (Appendix F.) is given a very good description of the changes in methods which have brought about greatly improved working conditions during the years between 1895 and 1910. While the chief hazards throughout the industry are recognized as exposure to intense heat, long hours, laborious work, weather exposure, and the breathing of escaping gases, smoke and fumes, we give herewith a synopsis of the chief *occupational diseases*:

Occupational Diseases of the Iron and Steel Industry.

1. Heat stroke ("apoplexy"), heat exhaustion, heat cramps, heat anemia, and heat diarrhœa.
2. Asthma, bronchitis, tuberculosis and hemorrhages while at work, due to dust, sand, gas and fume inhalations, grinding processes, etc.
3. Premature senility in older employes.
4. "Gassing," producing chronic symptoms as headaches, dizziness, vomiting, coated tongue, *anemia*, palpitation, insomnia, general debility, mental dullness; later, depressive insanity.
5. Conjunctivitis, due to heat, sand and dust. Injected or blood-shot eyes.
6. Cataracts among those exposed to white heated metals.
7. "Sun burn" of arms, hands, face, due to exposure to heated metals. Small hemorrhages under the skin of the face. Blistering.
8. Foot calluses, due to walking over hot iron plates, etc. Severe callusing of the hands.

9. Rheumatism and lumbago, due to great temperature variations.
10. Heart disease, perhaps evinced by sudden death while at work.
11. "Hammer-man's paralysis" of arms, due to use of heavy sledges. Also due to penumatic tampers and other pneumatic tools, particularly with long strokes.
12. "Striker's arthritis" of wrists and elbows, due also to hammering, or holding vibrating tools.
13. "Boilermaker's" deafness.
14. Ferro-silicon poisoning.*
15. Chief causes of death (U. S. Census, 1910):

Causes of Death.	*Percentage.*
(1) Tuberculosis	16.3
(2) Accidents	16.2
(3) Pneumonia	10.8
(4) Heart Disease	10.0
(5) Bright's Disease	6.6

* *Ferro-silicon poisoning.*

1. Composition: Fe Si or Fe_2Si.
2. Used to reduce the amount of carbon absorption in iron and steel, to cause molten steel to remain fluid for a long time, to prevent blow holes in castings and to soften the product. Is used in all processes of iron-making.
3. Appearance: hazel-nut fragments, gray metallic color, hard, brittle, if powdered producing a peculiar onion-like odor. Usually kept in casks.
4. Made from:
   (1) Iron and steel shavings or iron oxide.
   (2) Quartzite or sand-stone (95% silica).
   (3) Anthracite coal or pitch. Mixed in the cold state and fused usually in an electric furnace, then broken up into small fragments with hammer.
5. Where silicon is present to the extent of 30 to 60% dangerous gases of arseniuretted and phosphoretted hydrogen are liable to be produced especially in the presence of moisture. Where silicon is present below 30% or over 70% in the compound the dangers are practically nil.
6. Is very explosive in storage rooms. The main dangers are in the transporting and storage of that form made by electricity.
7. That used in blast furnaces not dangerous (too low grade).
8. Storage rooms should be especially well ventilated.
9. Symptoms. Usually of a few hours' or days' duration: dizziness, general pains, abdominal pains, nausea, vomiting, diarrhoea, bleeding, loss of consciousness, coma, sometimes simply found dead. Apt to be diagnosed as gastro-enteritis, ptomaine poisoning, or pneumonia. (Abstracted from Supplement to 38th Annual Report of Local Government Board, Gr. Bt., 1908-09).

The reader is also referred to the detailed tables of *morbidity statistics* in connection with the report from a large establishment in this industry. (pp. 56-59).

In the 23 establishments which our investigators visited, employing a total of 28,195 wage-earners, the following conditions were found to obtain:

(a) A workers' welfare department existed in 13 of the establishments, employing a total of 24,142 wage-earners. Of these establishments at least 10 had an excellent organization, which devoted a considerable part of its time in the development of means to conserve the health of the workers, in addition to the elimination of accident hazards. In the remaining 10 establishments employing 4,053 workers no such department existed, and oftentimes the attitude toward the health and welfare of workers appeared very indifferent.

(b) General sanitary and working conditions, such as protection against heat, freedom from prolonged laborious work, rest intervals of sufficient frequency, and sanitary provisions in the way of lavatories and toilets appeared hygienically good in 8 places (employing 12,020), fair in 6 places (employing 12,065), but poor in the remaining 9 places (employing 4,110). In 14 of the total establishments (employing a total of 15,584 wage-earners) there were no washing facilities. Workers had to wash in tool "bosh tanks," or under a hydrant, but, as a rule, went without washing. The type of closet accommodations was poor in 6 plants employing 1,462 workers. In these the simplest kind of primitive outhouses, usually without sewer connections, were present.

(c) The workday varied greatly in the different departments of the same plant. For hot-process workers, as, for instance, those engaged on the mills, and at the furnaces, the workday was reduced to 8 hours in 9 plants, in some of which a noon recess of ½ hour was allowed, and in others, none. In 3 other plants a 9-hour schedule was in vogue at the time of the investigation, while in the remaining 11 plants, the hours ranged from 9¾ to 13 per shift. In numbers of plants in which hours were short for hot-process workers, they were upwards of 10 to 12 per day for the general labor about the plants.

(b) In 6 establishments there were sick and death benefit associations as well as pension schemes, to which, however, only a part of the workers belonged in most places.

IRON AND STEEL. — BLAST FURNACES.

Blast furnaces were investigated in 8 plants, where 1,653 men were employed at the different operations. Of these, 4 plants were of modern type (employing skip hoists with automatic dumps instead of men for top-fillers). The chief hazards were *heat,* which seemed great for the keepers, the hot blast men, the keepers' helpers, the iron carriers, sanders up, scrappers, cinder bank men, and top fillers. The next hazard was *fatigue,* which was due to periods of laborious work, as well as long hours. The third hazard appeared to be the liability of contracting *communicable diseases,* through spitting into sands and dusts present and in some places absent washing facilities and very crude closets. The fourth hazard was the amount of *dampness* due to water and steam which arose from the granulating pits or the quenching of the cinder. Thereafter, *dust,* and *weather exposure* were present. The hazard of *poisoning* was due to the escape of gases which involved the top-fillers especially, the stove men next, and, thereafter, perhaps any of the workers often due to accidental leaks. *Complaints* were made in almost all places of the excessive heat, great variations in temperature, of the frequency of rheumatism, bronchitis, and digestive troubles. As a rule, however, marked exposures were

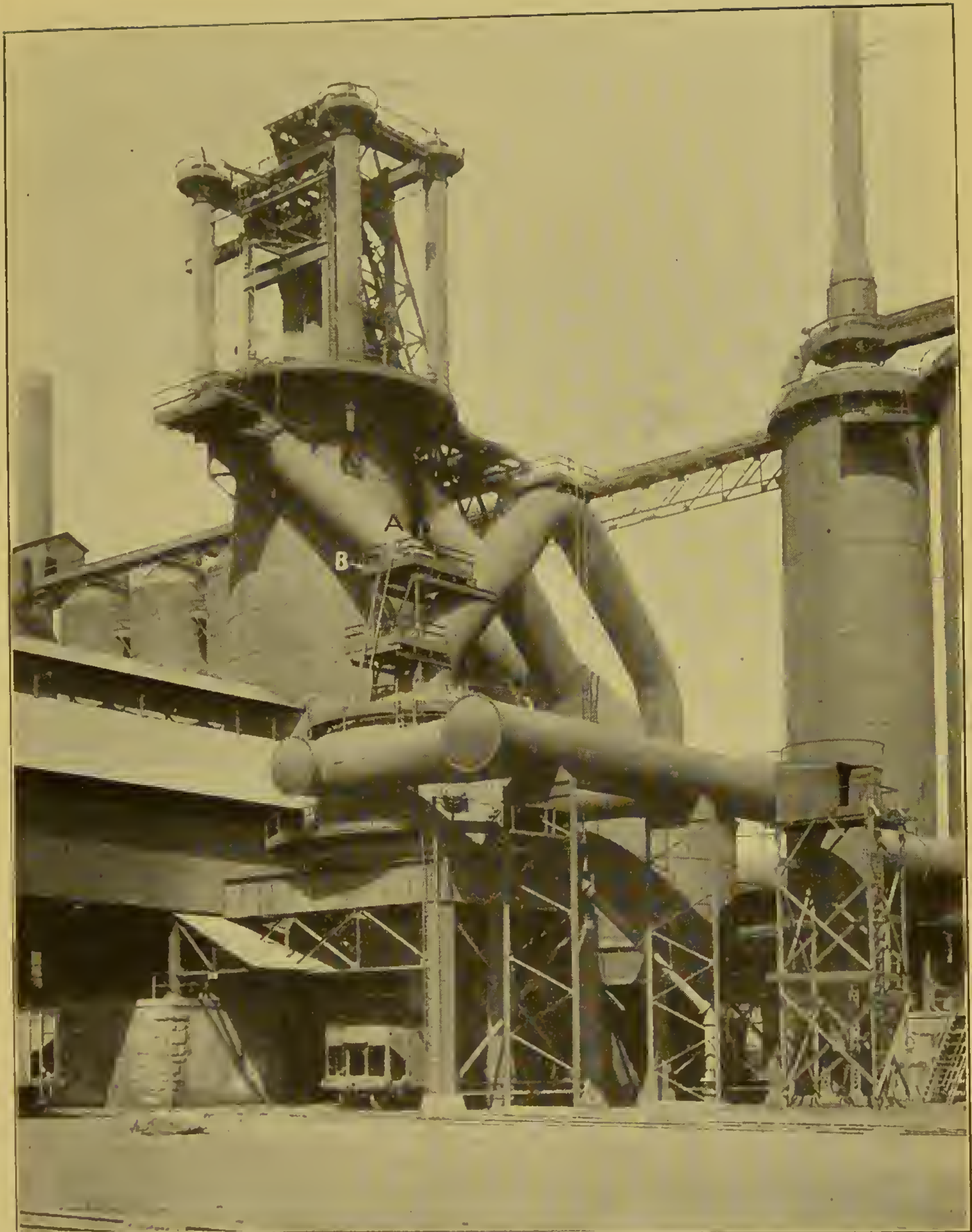

FIG. 87. THE BLAST FURNACE.

General view of a Blast Furnace completely equipped with stairs, ladders, railed platforms, etc., as a means of ready access to any part of the furnace, on account of the possible danger of being overcome with Blast Furnace Gas, and also as a matter of convenience and general safety to employes.

short-intervaled to both heat and excessive labor. *Comments.* — Labor saving and health conserving mechanical appliances were adopted in the modern plants consisting of electrically operated scale cars, skip hoists, carriage ladles for transporting the iron directly to the Bessemers, open hearth or pig machines, mud guns to stop up the tap holes in the furnaces, slag ladles, and granulating pits. Also it is well to mention the 8-hour shift adopted in one place visited, and also present in another large plant (the blast furnace section of which was not inspected), good shelter houses, lavatories, including shower baths and change rooms; also medical supervision, and special selection of workers for this process.

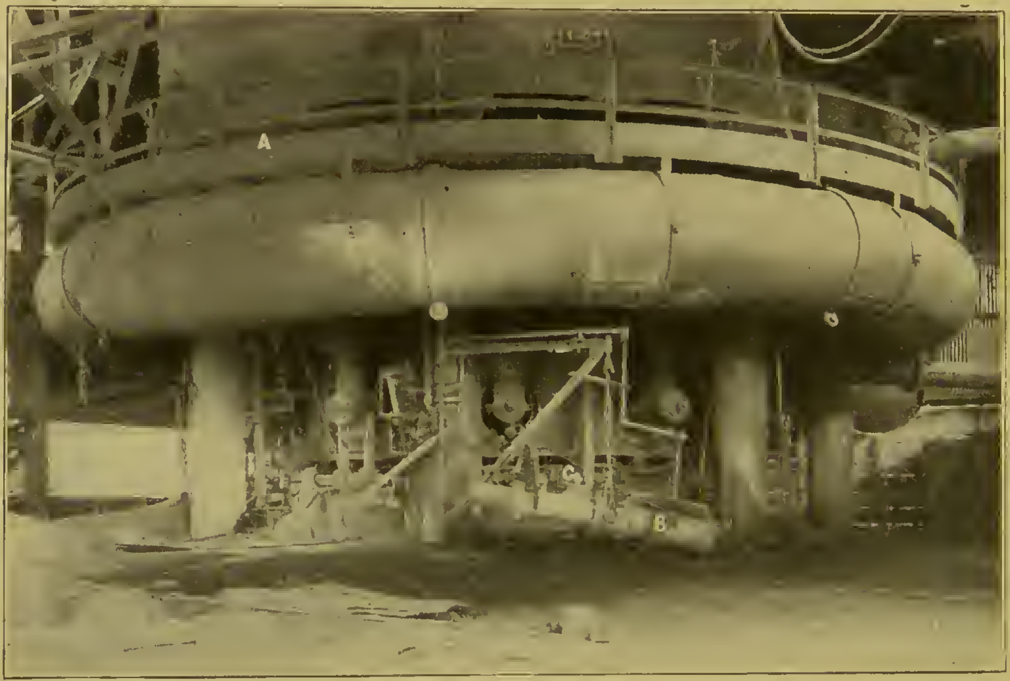

FIG. 88. THE BASE OF A BLAST FURNACE.

Railed walk "A" on bustle pipe of a Blast Furnace, where there is danger to workmen, who are occasionally required to go on this platform, of being overcome with Blast Furnace Gas. "B" mud gun which eliminates hand work in stopping up tap holes. "C" opening in gun for introducing clay balls.

IRON AND STEEL. — BESSEMER FURNACES.

The Bessemer furnaces in 2 large and 2 small establishments were seen by investigators. A total of 400 employes were found employed. One of these plants was thoroughly modern in all equipments, 2 others fairly so, and the third one not so. A work shift of from 8 to 9 hours obtained in 2 places, and 12 hours in the remaining 2, the noon recess being ½ hour in all places. The chief hazards were found to be exposure to intense *heat* which was bad in 2 places; the breathing of metal and sand dust; dirt floors and generally *disorderly* surroundings in 3 places; *dark* quarters in 1 places; contamination of the *atmosphere* with gases and smoke as well as dust which was bad in 1 place; the *long workday;* the liability to to contracting *communicable diseases,*

due to promiscuous spitting into the dusts of the floors (which were being constantly walked through and worked upon) and, in 2 places, to the absence of washing facilities and proper toilets. The table submitted below is abstracted from the U. S. Government Report, previously mentioned, and shows the improvements which have been made in modern plants, invariably to the saving of the workers concerned:

BESSEMER FURNACES.

Old Style Plants.	*Modern Plants.*
Metal Wheelers (barrows)—Laborious one-wheel carts, weather exposures.	Less laborious two-wheel carts, same.
Coke Wheelers — One-wheel carts, dust.	Two-wheel carts, same.
Top Fillers—Laborious, gas and smoke exposure, flame exposure.	Still laborious, charging machine used, no open-top cupolas.
Cupola Foreman and Iron Tapper — Very hot (tapping and plugging), constantly exposed, no protection against heat.	Same.
Ladle Car Engineer—Very hot.	Same.
Manganese Man — Intense heat while adding Mn., intense heat while rabbling, danger of being splashed with molten metal.	Same. No rabbling done.
Vessel Foreman and Helper—Intense heat in patching lining and changing bottom of vessel.	Less often done, some shields used; still very hot and hard work.
Blower and Regulators—Intense heat from ingot cars, danger of being splashed with molten metal.	Position entirely changed away from heat and danger.
Steel Pourer, Capper, and Test Man—Intense heat, danger of being splashed with metal.	Same.
Vessel Cinder Man — Intense heat, weather exposures, danger of being splashed with molten metal.	Overhead cranes and slag boxes make somewhat better.
Bottom Maker and Helper—Laborious work.	Same.
Bottom Oven Fireman—Coke gas.	Producer gas now used.

Old Style Plants.	*Modern Plants.*
Shakeup Men—Exceedingly hot, exceedingly laborious.	Ingot stripper and electrically operated plunger eliminate hazards entirely.
Ingot Stripper and Helper—Great heat, great danger for helper.	Better position, less heat. No helper required.

IRON AND STEEL. — OPEN HEARTH FURNACES.

The open hearth furnaces are said to be a matter of 15 to 20 years development in this country. The furnaces of 6 establishments were investigated in 6 different cities where 541 men were found to be employed in connection with these furnaces. This process was well handled mechanically and health-hazards were less than in most other furnace departments in the industry. In 5 plants construction appeared fairly modern, and, in 3, various health appliances were excellent. There was some exposure to *dust* which was quite bad for some workers at times and consisted of sand, earth and iron oxides chiefly. quarters were very spacious everywhere, and but few workers were employed in relation to the space occupied by the process. Quarters were very *dirty* with metal and dust accumulations in 4 places. *Light* was poor in 1 building. General *ventilation* was fair to good in all places. The chief hazards seemed to have to do with the keeping of the furnaces in action and not while they were working satisfactorily. In certain instances workers were at times greatly exposed to *heat,* particularly while patching linings or inspecting or stirring the metals within. During this time most of them put on dark colored glasses and wore face shields. Because of the long rest intervals, periods for recreation were probably sufficient in all places, but 11 to 13-hour shifts obtained in all places visited, with the absence of a regular noon recess in some. The liability to contracting *communicable diseases* was the same as for the other furnace departments. In some of the places the men were required to furnish their own colored glasses. Below is given a synopsis of the hazards of this industry as determined by the U. S. Government investigation.

OPEN HEARTH FURNACES.

Health-hazards.	*Corrections or Improvements.*
Long hour (12 hours) 27% to 52% active work time.	Men always changing relative positions.
Heat depends on building arrangements especially.	(Corrections obvious.)
The "mixer" very hot for few men especially if breeze in wrong direction.	Properly ventilated roof. Placed in separate building.
Two rows of furnaces placed back to back makes heat very intense on tapping sides.	(Corrections obvious.)

Health-hazards.	*Corrections or Improvements.*
Old brick or iron type furnace fronts—heat uncomfortable 20 feet away (closed), and 30 feet away while charging.	Water-cooled doors, ports and fronts.
Working the metal—heat for worker 150 to 180°. Repairing the hearth—heat for workers 150°. Testing—heat for worker 150°. Barring taphole from front of furnace. Heat for workers 135-180°	Heat reduced to 120°. Exposures short-intervaled. Wear face shields, blue glasses, long-sleeved flannel shirts, heavy shoes.
Charging by hand—Furnace doors open continuously 1½ to 2 hours. Heat 150°.	Machine charged — heat for operator 14 to 20° higher than for outside heat. Brief intervaled.
Making bottom—Actual shoveling, 22 out of 33 minutes. Dust from powdered dolomite. Magnesite often catches fire and men work in zone until work is finished. Men literally bathed in persipration at end of turn.	Should wear respirators(?)—personal measures as above. Work not exhausting.
Back of furnace—Heat exposures (all short). Tapping furnace hole, very hot. Recarburizing molten metal, very hot. Ladle craneman often very much exposed.	In modern buildings temperatures much less.
The pit—Metal and slag accumulations, very hot.	All run into cars and hauled off at once.
Pit casting and stripping ingots:	Not done any more.
Mold cappers often walked on molds of molten metal, exposed to fierce heat, fatal accident, heat stroke.	Ingots not cast in pits any more.

IRON AND STEEL. — PUDDLING FURNACES.

Iron puddling is a process which has remained the same for at least 50 years in manner of procedure, according to reports. However, it has been largely supplanted by the Bessemer furnace, which, in itself is being supplanted by the Open Hearth furnace. It is probably that in time electric furnaces will supplant all.

Puddling was investigated in 2 establishments, located in 2 cities where 495 wage-earners were found employed at the processes of "puddling," helping, apprenticeship work, "scrapping" and "muck-rolling." General laborers

are not included in these figures. A strong union was found to exist in this process. The attitude toward workers, the type and skill of workers, and their retention appeared good in both plants. Health appliances consisting of water-cooled fronts were present in all instances. The general construction of work quarters was hygienically good in 1 place and not so in the other, due to old type of buildings.

Dust was some feature in 1 place where dirt floors existed, and *cleanliness* was difficult to maintain. The general *ventilation* of quarters was good in 1 place but only fair in the other, due to contamination of the air with fumes and gases. In both places the puddlers, especially, were subject to the intense *glare* of the molten metals within the furnaces,, and workers were not found to be using any protection to the eyes, such as dark glasses. *Heat* was a considerable factor in both places in spite of the water shields. In 1 place there was a long exposure to the heat of molten masses, while pushing the "muck" to the rollers who worked some distance away. In neither place were there washing facilities other than the tool bosh tanks. One place was considering the installation of shower baths. The puddlers' time exposures to the heat ranged from 30 to 45 minutes. The evil effects of exposure to *cold* and chilling, because of stepping outside of the furnace zones to cool off, was present as mentioned in other furnace processes. *Fatigue* appeared a severe hazard in both places because of laborious work and piece-work, while using the body for pressure purposes, and the presence of loud noises were also noted. The workday was 9½ hours in 1 place, with 1 hour noon recess, and 8 hours in the other place, without special noon recess. The liability to contracting *communicable diseases* appeared considerable in 1 place and a fair hazard in the other, due to promiscuous spitting, especially upon dirt floors, common drinking vessels, absence of lavatories, and poorly fitted closets, especially in 1 place. In both places workers had to go outside to closets.

The general appearance of workers was fair to good in both places, as far as their physical conditions were concerned. The inducement to *alcoholism* was considerable in this process, due to the heat and fatigue factors, as well as the fact that the water supply was not convenient for a large part of the workers, and there was no attempt to regulate its temperature, so that in summer it was probably used too cold. The principal *complaints* of the workers were the frequency of colds, rheumatism and heat cramps in the warmer seasons. The rollers, particularly, seemed exposed to great heat, fatigue, and drafts. They were accustomed to wear face masks for protection against explosions when the water used blew off scale and cinders. One plant claimed only 5 heat prostrations during the entire summer, although there were 5 cases of heat cramps during the day of the investigators' visit. This was said to be unusual and explained as due to the rain and humidity on that occasion.

Comments.—The observations taken by the government investigations show that the puddlers themselves work in a temperature of 20 to 35° higher than the outside temperature, and average about 35 minutes to a heat, there being 6 heats to a turn or shift as a rule. Artificial ventilation by means of fans and air blasts are used in modern places. Our investigators found that there was a tendency, however, to use larger charges, and to bring the "heats" closer together.

IRON AND STEEL. — FURNACING.

In 15 establishments investigated in 9 cities there were 1,608 employes who were engaged in heating, welding, annealing and "soaking pit" furnace processes, including cranemen. A large majority were engaged upon the various mechanical devices used in placing iron and steel material into furnaces and removing the same from the furnaces. In 6 plants, where however, much of the work was manual labor, the workers using hooks, tongs, bars, rollers, etc. The need of health appliances to protect workers from the heat was obvious in all places, and particularly so for those in 6 plants, they were not protected by any sort of modern devices. In 7 plants, however, such appliances were found present and usually quite efficient. The general construction of the

FIG. 89. PROTECTION AGAINST HEAT.

Note water cooled door, movable heat shield, ventilating fan, and spacious quarters. A modern steel works.

buildings in which these furnaces were located appeared hygienically good in 10 places and bad in only 1, the balance grading in between. Other processes were frequently present in the vicinity of such furnaces, such as Hot and Cold Rolling, Pickling, Open Hearth Furnaces, and the like.

The chief hazard for this class of workers was the exposure to *heat* given off in the process, which often, also, greatly heated the iron floor plates. It was of severe degree, particularly in the warm weather. While these workers were not constantly exposed, they did not work in alternating squads in some places as was the custom at others, so that rest intervals were often much too few. In many places they were without the advantages of washing facilities, other than tanks of water used to cool hot tongs. In only 3 plants were they

furnished shower baths, while in most places the heating of quarters away from the immediate vicinity of the furnaces was not provided for. They were also exposed to the disastrous effects of heat alternated with *cold* in stepping outside to cool off. Next in importance came the *fatigue* hazard due to laborious work, long hours, prolonged strain, the effect of intense light upon the eyes (from which very few were protected by goggles or dark glasses), and the presence of deafening noises. This class of workers had more exposure to the gases from furnaces and especially from the heated metals removed from the furnaces than those in the hot mill work, as the former were the first to come in contact with the products after their heating. The effects of slow gas *poisoning* seemed easily possible for many such workers, while the danger of acute "gassing" existed only when leaks occurred or they approached

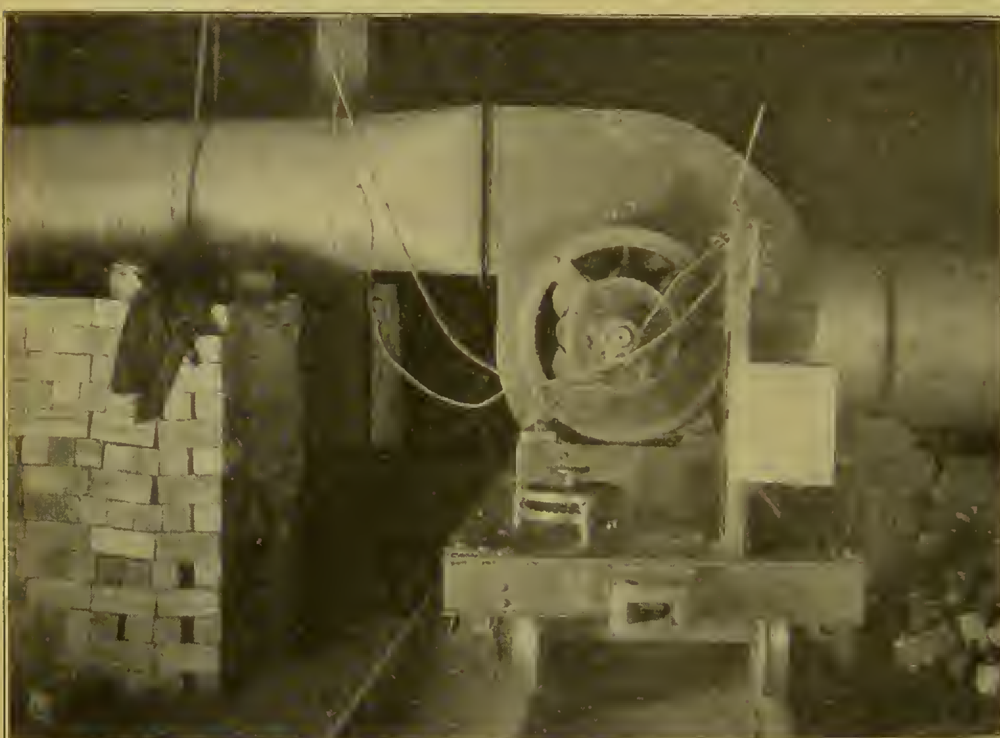

Fig. 90. A Health Appliance in a Modern Steel Works.

Portable ventilating fan used to furnish cool air to workmen required to enter a furnace or flues while the brick work is still hot.

furnaces too closely as in renewing bottoms, patching, etc. In 1 or 2 places these workers were in the same quarters where lead tempering was done, and in another place where brazing was done. In 12 places floors were of iron plate or brick construction, and kept fairly free of *dust*, but in the remaining 3 places the atmosphere about some furnaces was badly contaminated. Smoke was frequently dense. In 6 places quarters appeared more than usually *disordered*, so that it was difficult to keep them clean and (we would consider) safe. The general *ventilation* of the buildings appeared good in 9 places, fair in 2 others, and poor in 2 places (where furnaces were crowded). The liability to the contraction of *communicable diseases* seemed negligible in 2 places, fairly so

in 10 more, but bad in the remaining 3 places, where common towels were at hand, common drinking cups were used, wash places and closets were primitive or absent, and, as usual, spitting was promiscuous. We give below an abstract from the U. S. Government Report showing some of the improvements in some modern furnace quarters over those of old type.

Plate Mill Furnaces.

Old Style Methods.	*Modern Methods.*
Old Style Methods.	*Modern Methods.*
Pilers—Started 1 hour earlier (4 a. m.). Moved heavy buggies by hand. Danger of buggies turning over.	Narrow-gage locomotives do all this.
Chargers, Heaters and Helpers—Pieces hand-pushed into furnace. Pieces hand-pulled out of furnace. "Most laborious character" of work. Floors or iron plates, so hot, necessary to cool off with water. Very hot in summer, cold in winter.	All charging and drawing done by one man operating an electrically driven machine.
Make-shift of water-cooled doors.	Effective water-cooled doors.
Renewing of furnace bottoms very hot work.	Same.

Tube Bending Furnaces.

Charging—Hand work. On hot days often necessary to double and treble the crew.	Done entirely by charging machine.
Bending—Very laborious, hot work. Poor ventilation. Cool-air pipes were overhead and became hot.	Workers "spelled" for longer intervals, water-cooled doors, large electric fans for all zones of high temperature.
Tong Running—Fatiguing and hot.	Mechanical devices.
Rolling Off—The mule used for "rapid transit." Very irregular floors. Irregular buildings and roofs pocketed heat and limited ventilation.	Continuous processes and mechanical devices have eliminated the mule. Single enormous buildings.

Lap Welding Furnaces.

Furnace Pits—Hand-charged, heat extreme.	Furnaces raised and no pits. Mechanical pusher.
Taking and Rolling Off—Hot manual labor.	Eliminated by inclined traveling beds.

BUTT WELD FURNACES.

Feeders, Welders, Roller-offs, etc.—Hand-charging, hand-drawing.	Machine operations.
Taggers and Runner Boys.	Eliminated.

GENERAL FEATURES AND SANITARY CONDITIONS.

Cinder Wheeling and Similar Operations—Done by wheelbarrow.	All done by cranes or other machinery.
Urinals — Foul smelling; in remote corners.	Good system of lavatories; also garbage cans.

FIG. 91. GAS HELMET.

A special helmet supplied with air from a hand blower, to be worn by employes when it is necessary to work in furnace gas.

Closets—Disgusting privies.	Good system of toilets.
Drinking Water—(No particular care).	Plentiful, properly cooled and good. (Also bubbling fountains.)
Ventilation—Poor on account of nondescript roofs and multiple rooms, and numerous furnaces.	Spacious quarters greatly limit smoke, fumes and heat at working positions. Number of furnaces greatly reduced.

Cool Air Pipes—Ran overhead and became hot.	Below floors.
Washing Places—The boshes or tanks used for cooling tools.	(See above.)
Lighting—Gas and oil hand torches.	Scientifically arranged arc lights.
Movements of Raw Materials—Wheelbarrows and trucks, requiring an army of men and mules.	All materials and products mechanically handled.

IRON AND STEEL. — HOT MILL PROCESSES.

The hot mill work was investigated in both mechanical and hand mills Needless to say the most arduous work was in connection with the latter. In 22 mills investigated in 14 cities of the state there were found to be 9,404 wage-earners (all males) engaged at the various hot mill processes (mills, tables, shears, etc.).

A union organization existed in 1 of the plants investigated. The general interest of employers in the health and welfare of employes appeared good in 19 places, fair in 2 others, and quite indifferent in the remaining 1, where, however, some 400 workers were engaged at this process. The type of workers was an intelligent and steady class in 11 places, only fairly so in 10 more, and not so in 1. In many of the places a very large percentage of the workers were foreigners, often non-English speaking. In 17 of the plants various forms of health appliances were found present, usually to protect workers against the effects of heat, dust, smoke and steam. These consisted variously of screens, asbestos and glass shields, electric fans, air-blasts, curtains, and various mechanical devices which relieved the workers of the necessity of having to approach the heated metals so close. In 5 of the 17 plants these arrangements were, however, clearly not efficient. In 9 of the establishments organized instructions concerning personal health and hygiene were given, usually as auxiliary to the "safety first" propaganda which was being advocated in most places. In 7 of the plants workers had the privilege of joining sick benefit associations. Other processes than hot rolling were frequently present, such as (1) Furnaces (closely placed), (2) Bessemer Furnaces, (3) Pickling, (4) Cold Rolling, (5) Machine Shopping, and (6) Metal Grinding. The age-group estimations summed up as follows: over 45 years, 68; between 40 and 45 years, 307; under 40 years, 8,124.

Dust was a negligible hazard in this process in 15 plants, but a fair hazard in 6 more, and bad in 1, a small place, where grinding was also done in the same quarters. The mill rooms were kept *clean* and orderly, and well arranged in 14 places, fairly so in 2 others, and not so in the remaining 6, in some of which cleaning of the floors under foot appeared to be seldom done. Quarters were naturally well *lighted* in 13 places, fairly so in 6 more, but in the remaining 3 artificial light (and this in some instances quite inadequate) was depended upon. In some instances the intense heat to which the metals were brought made them sufficiently brilliant to prove damaging to the eyes of workers who were required to be close to them. But few of these wore colored glasses.

The general *ventilation* of these mill rooms where the workers were required to be was good in 7 establishments, while, in all of the remaining, a considerable part of the men worked in vitiated atmosphere. This was especially so in 3 places, all of which were large sized mills. The chief reasons for vitiated atmosphere were contamination with the gases given off by the metals, pollution with smoke and dust, and, to a limited extent, with salt-water sprays and steam. The absence of means to promote a more rapid circulation of air was an important factor. *Heat* was, of course, present in all places, but in 3 plants workers were so well protected by various mechanical appliances, and by frequent rest intervals, that they appeared to be free from material harm from this source. In 6 other plants this was so to a large extent for most of the workers, but in the remaining 13 mills a good percentage

Fig. 92. In A Pipe Mill.

Protection against heat. Note shields, spacious quarters and high ceilings.

of the workers were inordinately exposed to the temperature of the heated metals, hot rolls, and hot floor plates. In some of these, certain appliances were at hand, but they were only partly efficient, or out of order. As great a hazard as any to which these workers were subjected was the alternate exposure to *cold* by going out from hot vicinities to the open sides of buildings or elsewhere while in a perspiring condition, to cool off. Many times they sat down on benches in the direct draft or wind, and presently returned to the work, this alternation being kept up throughout the day. In the winter time some of the plants were very inefficiently heated, or there were no heating arrangements at all. In such places it was practically the temperature of the outside weather in the outskirts of the mills, while upwards of 100° to 150° in places where the workers were required to be. In a number of places open coke

salamanders were depended upon for heating premises in the winter seasons, and gases from these polluted the atmosphere for great distances. Another chief hazard in the industry was *fatigue*. While this was rated as nominal in 3 plants, it appeared to range from fair to bad in the other 19 plants. The chief factors were laborious work, long hours, prolonged strain, "speeding up," and, for numbers of persons, monotony, jarring processes, prolonged faulty postures, and severe pressure against the person. In practically all places deafening noises from the mills and the movement of products were present, oftentimes so marked that it was impossible to make oneself heard in the vicinity. The liability to the contraction of *communicable diseases* appeared fairly negligible in some 12 plants, while in the remaining 10 there were a number of opportunities for contracting disease, one from another. These were, chiefly, inadequate washing facilities, primitive toilet arrangements, promiscuous spitting upon the floors, the absence of cuspidors, frequent trivial injuries, flying particles, the infection of calluses without prompt first-aid arrangements, and (less often) to the use of common drinking cups or jugs of water, and towels. In a considerable majority of the places bubbling fountains were present, and some plants were excellently equipped in sanitary features, including individual lavatory basins, hot and cold water, soap, model toilets, showers, change rooms, double lockers (one for street clothes and the other for shop clothes) and everything procurable in the matter of first-aid equipment, while physical examinations, medical supervision, and a selection of the workers for the processes at hand were given every thought. There were also furnished goggles, hand-protectors, gloves, and, where needed, leather aprons, while a careful supervision was made of the types of shoes worn. The only liability to *poisoning*, which investigators could ascertain, was from the effects of inhalations of carbon monoxide and carbon dioxide gases emitted by the hot metals worked upon in nearby furnaces, or salamanders. The results of these might easily be slow chronic poisoning, although their concentration was probably never enough to cause asphyxia. The industrial inducement to *alcoholism* was considerable for the workers in most of the plants, due, chiefly, to the depressing effects of heat-toxins combined with fatigue-toxins, resulting from the work. Where drinking water was not carefully supervised as to quality, temperature, and convenience, there was an additional great inducement for workers to quench their thirsts otherwise whenever opportunity offered.

The general *appearance* of workers in these mills was fairly good in practically all places. The large percentage of men under 40 years of age, and many of these recent employes, should be considered, however. It is true that a fair number of pale and anemic, fatigued, and many heat-suffering workers were seen, and *complaints* of rheumatism, lumbago, heat colics in the summer time, heat prostrations, diarrhea, heat-skin affections ("sun-burning," blistering, dermatitis, blood shot eyes), and heat exhaustion were common. In one place it was admitted that many "succumbed to heat", and two were overcome with heat while investigators were present.

Comments.—If the various commendable features adopted in various plants, or those made use of in 2 or 3 of the best equipped plants, were adopted throughout the mills inspected, there would be a great reduction of hazards in this process. Heat is probably the chief hazard, although it is impossible to say that *fatigue* is not worse. After these the breathing of hot, smoky and gaseous atmosphere is another arch health-hazard, while jarring

and jerking processes, and excessive noise are other features. Some of these, of course, it would be quite impossible to eliminate. The introduction of the small continuous mechanical mills for hand mills greatly limits the hazards. A more frequent alternation of workers would help to solve some of the situations. A special committee in each plant should investigate and devise means of curtailing the hazards above mentioned. Every case of sickness among workers (these men are at the prime of their existence) should be the subject of an inquiry with a view of preventing a repetition of its cause if any industrial or preventable factor is at the bottom of it.

IRON AND STEEL. — COLD MILL PROCESSES.

A rather small proportion of iron and steel mill workers are engaged in work upon cold roll processes, while there are usually a vast number of laborers working in the vicinity of these mills. The health-hazards of this type of work are very much less than hot rolling or furnacing, but the factor of *fatigue* plays an important part in the illnesses which affect these workers. It is due to the whole list of fatigue causes variously prominent in different places. Usually, the work is piece-work and is also of an arduous character, while the hours are long. There is rather more *dust* connected with the process which comes from the more or less oxidized iron and steel which has lain aside for certain intervals of time before getting to this process. These workers are also troubled with *calluses* of the hands. The noise from the rolls is deafening and many of the workers are affected thereby. The cold rolling is often done near the hot rolls and these workers are subject to the hazards of this process. Absence of heat in the winter time is to be considered a much less hazard for the men about cold rolls than for hot process workers who leave the rolls and tables to cool off.

IRON AND STEEL. — WIRE DRAWING.

The processes of wire drawing were investigated in 2 plants, where a total of 224 wage-earners were found so engaged. The work was very largely mechanical and easily supervised by laboring crews, the majority of whom were foreigners, mostly non-English speaking. They appeared to remain well at the process, and in 1 place were provided with boots and hand protectors; also had sick benefit and pension privileges. They were practically all under 40 years of age, with a few under 20. The construction of work quarters was good except for some of the processes in 1 plant, which were located in a low-ceilinged, damp, dark basement, artificially lighted.

The hazards of the process appeared to be only nominal. In the coarse wire rolling departments there was considerable flour *dust* in the air and upon the floors. The work was rather *damp* and sloppy, due to the vats of flour water which were used for lubricating purposes. The atmosphere had a sour *odor* from the fermentation going on in the vats. One plant was equipped with shower baths and generally good *sanitary* conveniences. There were also present cuspidors and proper drinking facilities. The other plant was very poorly so equipped. The process itself appeared to be devoid of *poisoning* hazards, but the Galvanizing, Copper Plating and Tinning had hazards as described elsewhere. In 1 place in particular risks of poisoning from copper sulphate and strong sulphuric acid vapors were present.

The general *appearance* of workers was fair to good in both places. The only complaints were irritation of the throat and coughing, in the Galvanizing

and Tinning processes. *Comments.*—Rubber gloves or other hand protections were badly needed in 1 place. There appears to be a possibility of yeast dermatitis in this class of workers, although no cases of the same were brought to our attention.

* * * *

The balance of Iron and Steel workers who are engaged in health-hazardous work usually fall into such processes as Machine Shopping, Forging and Blacksmithing, Tempering, General Factory Processes, etc. (q. v.).

LEATHER TANNING.—CHEMICAL PROCESSES.

The majority of special workers in tanneries are employed in the various chemical processes. As investigated in 8 plants in 4 cities, there were a total of 268 men engaged in these processes, which consisted in placing the hides in lime vats; scraping them (tacked on beams) to get rid of hair; fleshing and scrubbing; oiling with so-called cod-liver oil, which was done by hand, using a small board; tanyard processes, which consisted of grinding the oak bark, leaching the bark for use, and the making of the tanning solutions (oak bark, tobacco, etc.); subjecting the hides to the tanning solution; clearing processes, using weak sulphuric acid solutions; and a little bleaching, in which lead acetate was used. In only 1 firm was any chrome tanning done, and this was limited in amount.

Apparently modern methods were used in all except 1 small place. There were no unions. The interest of employers in workers' health and welfare appeared good in 3 plants, fair in 3 others, and poor in the remaining 2, where a total of 37 workers were employed. A fair type of workers was employed in 2 places, but the large majority were of ignorant, non-English speaking type in the remaining. Workers appeared to be retained fairly constantly in 4 places, while the personnel seemed subject to frequent changes in the remaining 4. There were no devices for these processes which could be called health appliances in any of the plants, while sick benefit and similar organizations were absent. The general construction of work quarters was not hygienically good in any establishment. Other processes were usually separate from the chemical processes here described, but, as a rule, several of these sub-processes were carried on in the same quarters. The age-group estimations summed up as follows: over 50 years, 3; between 45 and 50 years, 2; between 40 and 45 years, 20; under 40 years, 243. Of the last age-group about 10 per cent were under 20 years.

The only places in which *dust* seemed to be a hazard were in the hair room, where a limited amount of fine hair dust was present, and in the grinding up of tan bark, which was very dusty, and without protective devices. In 7 places quarters were very *dirty* and disorderly, and apparently seldom cleaned. *Dampness* and humidity were a considerable hazard in 2 places, and fairly so in 5 others, due to washing and soaking processes and the preparation of tanning solutions. *Light* was bad in 2 places, for a considerable percentage of the workers. Artificial lighting was usually by naked electric lamps. The general room *ventilation* for these chemical processes was good in 2 places, fair in another, but poor in the remaining 5, due, principally to contamination and pollution with vapors, odors and steam, as well as to stagnation of the air. *Heat* was no apparent hazard, except in the tan-bark leeching room of one establishment where it was excessive. *Fatigue* appeared to be a hazard in some operations. Lifting hides, cleaning and unhairing were laborious

operations with much stooping. The workday was 10 hours in all places, with a noon recess of ½ hour in 3 places, and from this to 1 hour in the remaining 5. In 1 place a 10-minute recess was taken both in the morning and afternoon. The liability to contracting *communicable diseases* was considerable in all places, due variously to poor or absent washing facilities, primitive closets in most places, the use of common drinking cups and wiping rags, promiscuous spitting, and the absence of cuspidors. A part of one plant was well equipped with bubbling fountains, good toilets and wash places. The liability to contracting blood poisoning and parasitic diseases from the handling of hides was apparent in all places, and was increased through the prevalence of dermatitis and eczema, due to the various chemicals used Many of the workers' hands were also very callused from the use of knives and boards in fleshing and rubbing processes. Workers were somewhat less liable to animal and filth diseases than those in the flaying rooms of fertilizing works. (q. v.) The risk of industrial *poisoning* was considerable in all places, but was usually of a mild character, due to the handling of hides soaked in lime solution, acid preparations, and weak sulphuric acid cleaning. Lead and chrome compounds were only limitedly used. Lead poisoning from the use of crude sulphuric acid was a possibility. The risk from arsenic poisoning from preservatives used on the hides as bought, and from realgar (arsenic sulphide) added to the lime to hasten unhairing could not be determined in the time at hand. The same applies also to the risk of cyanide poisoning from gas lime used, and hydrogen sulphide gas in the storage of green hides. The industrial inducement to *alcoholism* was considerable, due to the greasy, sloppy, *odorous* character of the work, while in 1 or 2 instances drinking of beer within the quarters was permitted during noon and at recesses.

The general *appearance* of workers was fair as to health, but they were usually covered with dirt and grease, while some anemic and sickly looking individuals were seen. The workers made *complaints* concerning the effects of irritating solutions upon the hands and sore throats from sulphuric acid clearing. *Comments.*—While this class of work is necessarily of an uninviting character, there appears to be no good reason why attention should not be given to daily cleaning of quarters, good drainage of floors, proper lighting, and ventilation. In all instances workers were required to furnish their own boots, while in others they worked barefooted. On the whole, the work is probably not as hazardous as would be imagined, and the chief objectionable features appertain to questions of general sanitation and personal hygiene.

CHIEF CAUSES OF DEATH:

439 tanners and leather curriers (U. S. Mortality Statistics 1909):

Disease.	*Percent.*	*Normal Per-cent among occupied males.*
Tuberculosis	15.2	14.8
Heart Disease	14.3	11.9
Pneumonia	8.8	8.0
Bright's Disease	8.7	8.5
Apoplexy and Paralysis	8.0	7.3

Hence all chief causes are above the average for occupied males.

Average Length of Life.

438 tanners and leather curriers averaged 52.9 years.
Decade in which most died, 45 to 54 years.

LEATHER TANNING.—DYEING.

The coloring and japanning processes upon leather were investigated in 6 establishments in 4 cities, where 254 men were found so engaged. About 240 of these were japanners, enamelers, or patent-leather workers, and their methods of work and health-hazards were about the same as described elsewhere under Japanning. The balance of the workers were engaged in coloring and mottling processes, including some hand rubbing. There were no unions. The general attitude toward employes, the type of employes, and their retention, did not differ materially from the statements made under these headings in the previous processes. In 2 places in which large numbers of japanners were engaged suction fans were located in the work quarters. The general construction of the work quarters was good in 1 place, fair in another, but hygienically bad in the remaining 4, one of which was a large establishment. In smaller establishments the work was usually done in quarters where rubbing and scrubbing of hides was performed. The age-group estimations summed up showing 10 workers over 40 years of age, and 244 under that age.

In 1 place emery *dust* was a limited hazard in the finishing room, while in 4 places quarters were *dirty* and disorderly, sometimes to an extreme, the floors being thickly coated with paints, enamels and oils. The chief hazard appeared to be the risk of *poisoning*. Black, yellow, white, red and green colors were used. In 1 place the mixer claimed that only a small amount of lead was used, the rest being anilin dyes. The principal complaint was of benzine used as a solvent. Mottling was done with a solution containing naphtha, amyl acetate and wood alcohol. The applying of colors in boiled linseed oil and naphtha was done by men who smeared and spread the mixture over the surface of the leather. These colors were prepared in a separate paint shop room, white lead and oil being used for white colors, lamp black and oil for black colors. The linseed oil was thinned and "dried" with naphtha, the odor of which was very strong in most places. In other places a solution of ferrous sulphate and tannic acid was used for black coloring. In some instances the black anilin dye "nigrisin" was used (in this connection one worker appeared to be faintly cyanotic, but made no health complaints). Logwood was also a common coloring solution. Another hazard in the process was exposure to *heat* from japanning ovens. Here and there a suction fan was present and materially alleviated the effects of heat. It was common to see men working in bare feet and stripped to the waist. In some places special rooms were arranged for drying purposes with steam coils on the concrete floors beneath the colored hides which were stretched on frames and stood vertically. The temperature of japanning ovens was kept at about 160-175° F., while the room containing the ovens ranged from 85 to 100° F. In 1 place it was customary on hot days to discontinue the work. The need of shower baths is evidenced by the fact that at the time of inspection in 1 place, which was at the close of the day's work, 6 men were naked and bathing in galvanized iron pails to get rid of the grease and naphtha. The plant also had three lavatory wash basins on each floor. Another hazard was *fatigue*. Piece-

work was the rule in larger plants, and on hot days the work appeared unusually exhausting in the patenting and japanning processes. The liability to contracting *communicable diseases* was the same as described for the chemical processes, except that the cured and tanned leathers did not offer a hazard from animal parasites and infections.

The chief *complaint* of the workers were of the heat, the dirty, greasy character of the work, and the effects of benzine or naphtha fumes. A considerable number of them were pale and anemic and sometimes dissipated looking. One worker in a paint shop where colors were mixed was unquestionably suffering from slow lead poisoning, while there was a suspicion of the same among a number of the color workers. *Comments.* — For most of these workers the same precautions should be observed as described elsewhere under japanning, while there is much room for improvement of sanitary conditions and cleanliness of work quarters, washing facilities, better room ventilation, and the like, in most of the places.

LEATHER TANNING.—HANDLING AND MANIPULATING.

A third group of workers in the Tannery industry, after those in chemical processes and coloring or dyeing processes have been considered, are those who may be conveniently grouped under the classification above. These include such processes as cutting, trimming, splitting, tacking to frames, and drying, preparing russet leather, polishing by hand or machines, "stuffing" or working stearin and grease into the leather, and "whitening" or the removing of the outer surface of the leather by buffing or by machine knives, leaving a whiter appearing coat beneath. In 7 establishments investigated there were 161 men employed in these various manipulations. They were usually of a more intelligent type than observed in the other processes, the work being partly of skilled nature.

Dust was of an abundant and fine character in the case of whitening. Blowers provided at the machines did not prevent the person of the operator from becoming well covered with this dust and considerable accumulation of it took place about the machines. Some workers *complained* of coughs, colds, etc. Scouring was done by means of "softening boards" (by rubbing the leather with emery paper tacked on wooden blocks and applied by hand), there being no protection from the dust created. *Dampness* was considerable in some of the trimming and splitting quarters. *Ventilation* of quarters was bad in some instances, and numbers of workers were working in *hot* stuffy locations, men often going about in bare feet. *Fatigue* was also some hazard to certain workers, as in "rolling" where workers forced the leather against rolls by means of foot levers, the thigh coming to right angles with the body in each movement. It was observed that one man made fifty-four such movements a minute. The work was piece-work. Other workers were required to remain standing still for long periods. The liability to contracting animal and *infectious diseases* was about the same as described for the chemical processes. Workers had the habit of holding tacks in their mouths, these being used over and over again by different workers. Another hazard was that of skin irritation or *poisoning,* due to stearin and grease used in "stuffing" and the handling of leather and hides recently treated with chemicals and colors. Many of the processes were associated with very nauseating *odors* to which the men were apparently habituated.

Comments.—While in one or two instances the plants were fairly modern in construction and fairly clean, considering the nature of the work, most of the places were very insanitary and generally health-hazardous. Here and there closets were out of doors and washing facilities were at a premium. While spitting was discountenanced in one or two establishments, there were no cuspidors supplied.

BOOTS AND SHOES.

The manufacture of boots and shoes for men, women and children is an extensive industry in the state, but after investigating 28 establishments located in 9 cities, and employing a total of 11,806 wage-earners, we reached the conclusion that from a health-hazard point of view the various processes

FIG. 93. BOOTS AND SHOES.
Leather cutting room.

were essentially those of General Factory Work, and that such hazards as existed depended more upon local conditions and methods of procedure than peculiarities inherent in the industry. On the whole, however, the general working conditions of the places investigated ranked higher than for General Factory Processes. In respect to the general conditions of work, the care of employes, the conveniences provided, and the protection from dust and fumes, the 28 firms ranked as follows:

No. of Firms.	Rank.	Total Employes.
11	Good	6,755
6	Fair to Good	1,345
5	Fair	2,514
3	Poor to Fair	605
3	Poor	587
Total 28		11,806

Sick benefit organizations were found to exist in 5 establishments, employing a total of 2,838 wage-earners. The working hours were as follows:

Fig. 94. Boots and Shoes.
Sole leather (fitting) room.

No. of Firms.	Hours per Day.	Noon Recess.
9	9	1 hour in 9 firms.
9	9	1 hour in 9 firms.
1	9½	½ hour in 18 firms.*
18	10**	¾ hour in 1 firm.

There were other arrangements also to avoid exceeding 54 hours per week.

Age-group estimations were not made by our investigators, but 1 establishment, employing a total of 1,699 persons submitted the following census figures, taken about the first of the year 1913:

* In 2 of these, females were allowed 1 hour.

** In 2 of these, females worked 9 hours, and in another 9½ hours.

Age-groups.	Males.	Females.
16-30 years	300	640
31-45 years	500	30
46-60 years	200	8
60 years and up	19	2
Total	1,019	680

Many of the plants investigated were among the best in the state, adopting the most modern methods, with an evident serious attitude regarding the health and welfare of employes, the retention of the same personnel of employes as far as possible, health organizations, benefit schemes, hygienic construction of work quarters, and the installation of health appliances. The subject of lighting

FIG. 95. BOOTS AND SHOES.
Cementing and pressing heel lifts.

was given considerable attention, and where it was necessary for numbers of persons to work facing the light, frosted windows, light window shades, and eye shades were provided. Two establishments visited were on the point of moving into new and modern quarters.

Complaints were made in a number of the best equipped plants that employes were not appreciative and thwarted efforts of the managements by such acts as plugging up bubbling fountains, plugging up toilets, spitting upon the floors where plenty of cuspidors were supplied, besmirching newly painted walls with tobacco spit, wads of tobacco, etc. However, the overt acts of a few em-

ployes were not allowed to deter the managements in their efforts, we are glad to say.

The chief health-hazards noted in connection with the different processes in the manufacture of men's, women's and children's boots and shoes are given below. The departments have been arranged to correspond with the divisions given in U. S. Labor Bulletin No. 154 (1914), as these divisions were found to apply almost throughout, with the exception that a number of sub-processes which the government bulletin places under "buttoming", were called "finishing" by managements. However, we have adhered to the arrangement given in the government bulletin, leaving "finishing" to include the "treers", or "ironers". One unavoidable procedure throughout the industry which may be distinctly hazardous is the short-intervaled handling of shoe

FIG. 96. BOOTS AND SHOES.
Fitting or stitching room.

parts by different workers, one after the other. It is said that "each shoe goes through a hundred hands". Callosities are very common for workers in the various processes. These often become sore and painful, and are a source of danger in case of cuts or punctured wounds, since blood poisoning so easily develops in such wounds.

CUTTING DEPARTMENT.—In 24 establishments there were 1,182 wage-earners engaged in the process of cutting leather, of whom 171 were females, employed at "skiving". The chief health-hazards were found to be: (1) overcrowding, (2) constant standing, (girl skivers stood up even where

stools were furnished), (3) hurrying piece-work in some places, (4) monotonous application, (5) promiscuous spitting, (6) facing the light without protection to the eyes, (7) some noise, (8) city smoke, and (9) crude methods of heating quarters. In one large plant little piece-work was done, in a number of others only a part worked piece-work. There were a number observed who were pale, anemic and otherwise under par.

SOLE LEATHER CUTTING.—This process was investigated in 13 plants, employing 278 males (there were no females at this work in any of the places). The chief health-hazards were (1) overcrowding, (2) poor ventilation, (3) piece-work (but this was relatively limited), and (4) some contamination of the atmosphere with cement fumes.

FITTING OR STITCHING.—In 25 establishments there were 3,295

FIG. 97. BOOTS AND SHOES.
Lasting room.

wage-earners employed in this process, of whom 106 were males, and 3,189 females. Sewing machine operations constitute the bulk of the work. The chief health-hazards were: (1) hurrying piece-work, (2) monotonous application, (3) sedentary work, (4) awkward postures, (5) jarring processes, (6) eye-strain, (7) noise, (8) crowding, (9) chairs or seats without backs, and (10) some workers handling (and breathing) shellacs dissolved in wood alcohol, and cements dissolved in naphtha. In respect to the two poisons last named, patent closed containers with automatic emitters were used in most places, but open bowls or cups were present in others from which the vapors

pervaded the atmosphere and caused a considerable amount of complaint and evidences of illnesses therefrom. It is not meant to state that all of the above health-hazards existed in all of the plants, for in this respect the plants have already been graded in respect to these in the first table given in this article. In numbers of places workers were supplied with chairs having adjustable backs.

LASTING. — The "last" processes were investigated in 25 establishments, employing 1,632 wage-earners, of whom all but 4 were males (the latter engaged in pasting toe-boxes). The chief health-hazards were found to be: (1) constant standing, (2) piece-work, (3) rather monotonous work, (4) awkward postures, (5) jarring work, (6) overcrowding, (7) promiscuous spitting, (8) heat from warming racks, (9) some dust in the atmosphere, (10) noise, (11) a little steam in the atmosphere, (12) nauseating odors from fish

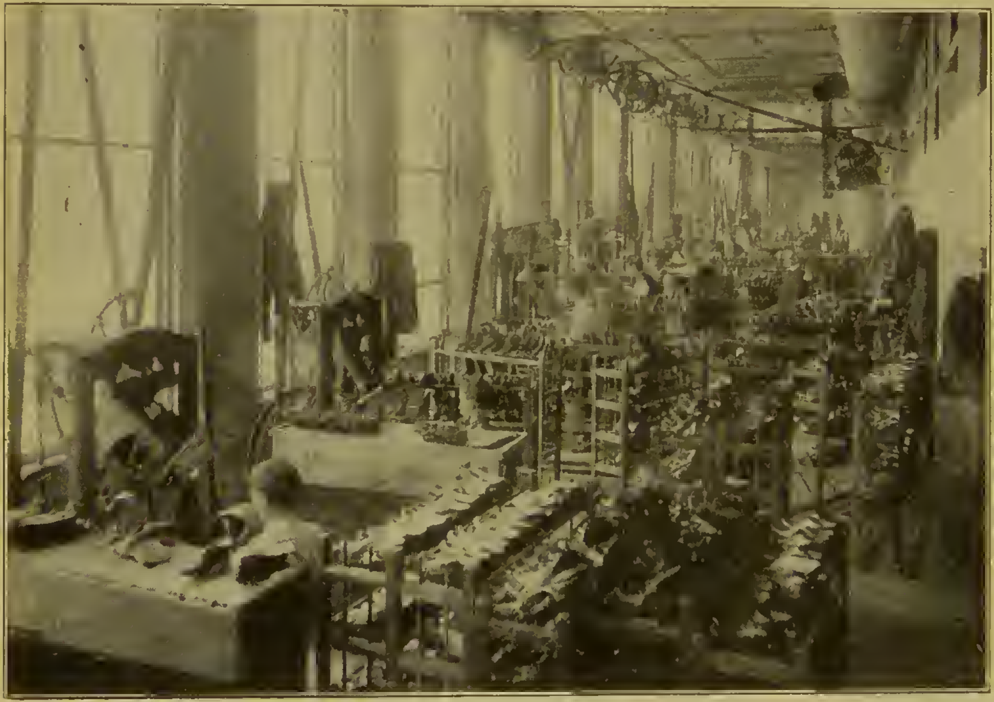

FIG. 98. BOOTS AND SHOES.
Bottoming room.

glue, and (13) the risk of chronic poisoning from handling and breathing cements dissolved in naphtha, and shellacs dissolved in wood alcohol. As elsewhere, there was some complaint of the usual symptoms caused by these poisons. In a number of places open containers, only, were present.

BOTTOMING AND BOTTOM FINISHING. — In 27 establishments there were 2,498 wage-earners engaged at the numerous processes included under this title. Of these, 2,276 were males, and 222 were females. The chief health-hazards were: (1) constant standing for many workers, (2) hurrying piece-work, (3) dust, composed variously of leather, blacking, wax, sand, emery, carborundum, bristles, lint, shellac, rosin, etc., which escaped from

poorly hooded polishing, buffing and scouring processes, or from wheels which were not protected at all, (4) monotonous application, (5) faulty postures, (6) pressing the body against shoe parts to hold them in position, (7) eye-strain, (8) jarring or jiggling work, (9) considerable noise, (10) overcrowding, (11) gas flames without vents which both deoxidized and contaminated the atmosphere, (12) nauseating vapors from blackening in close quarters, and (13) the handling and breathing of cements dissolved in naphtha, which, often, were not in closed containers.

FINISHING.—It was quite impossible to divide the "treers" or "ironers" from the inspectors, stampers, and in some cases, packers. In 24 establishments investigated, there were a total of 877 wage-earners, of whom 249 were males, and 628 were females.—These figures, however, are too high for "finishers" alone. As all worked in the same quarters, however, their hazards

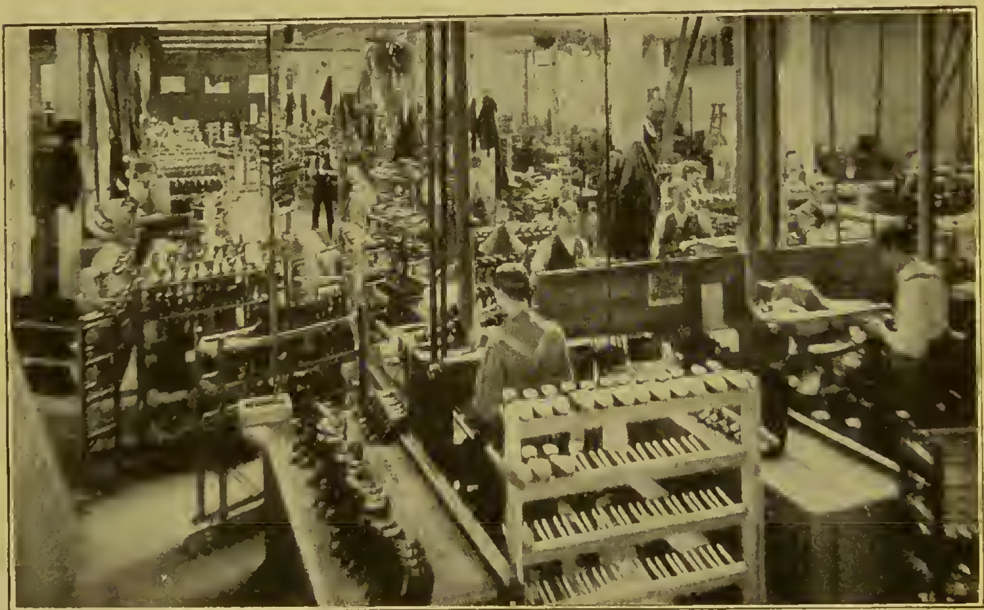

FIG. 99. BOOTS AND SHOES.
Finishing and packing room. Note exhaust vents on polishing wheels.

were quite similar. The chief health-hazards were found to be: (1) constant standing by females, who said they could not use seats and do the work, although they got very tired from standing, (2) heat from the ironing process, which was done both by hand and by machines, (in 1 instance, investigators on a hot summer day saw one girl overcome with heat in a plant where the ventilation for this work was not good), (3) unventilated gas flames which both deoxidized and contaminated the breathing atmosphere, (4) hurrying piece-work, (5) monotonous application, (5) faulty postures, (7) some jarring work, (8) pressing objects against the body, (9) eye-strain, (10) noise in some places, (11) some dust, (12) overcrowding, and (13) the breathing and handling of gasoline cleaning solutions, often used in open containers, and nauseating and intoxicating polish or blacking vapors, which, in close quarters, were marked. These were composed of such substances as naphtha, wood alcohol,

amyl compounds and ammonia. In numbers of instances workers were without gloves, and suffered from dermatitis in the polishing and cleaning work. "Banana oil," flowed over patent leather shoes to cover cracks, was another source of complaint.

WHITE COLORING OF SHOES. — This process was carried on in a few places, and appeared to be quite dusty in some instances, both from the application of the whiting and the "kicking up" of dust from the drippings which dried out on the floors. There were no analyses of this substance made to determine whether lead compounds were used (which is said to be the case in reports from other sources).

Comments. — The various hazards above cited in connection with the processes in different places suggest their own corrections. In a number of places practically none of them existed. If the good features in various plants were adopted for all, there would be a practical absence of health-hazards. — With large numbers of workers employed close together there should be a careful medical supervision, which should include a physical examination of all new employes, as well as an inquiry into the causes of sickness which necessitate absences from work. — The high death rate from consumption in this industry has been commented upon in Part IV. It is not peculiar to Ohio, as reports from other states and countries show the same, but these facts should not lessen the activity to fight this disease, the abolishing of the causes of which would greatly lessen most other diseases. Readers are also referred to the Bulletin of the Massachusetts State Board of Health, entitled, "Hygiene of the Boot and Shoe Industry" (1912), which describes, in detail, the various methods of removing dust from the different machines and processes, as well as methods to check up on the efficiency of different appliances.

TEXTILES.

The processes concerned here consist of those in the winding, knitting, cleaning, fleecing, washing, drying and turning of fabrics in the manufacture of cotton underwear (these employed 84 males and 43 females in 4 establishments), and the combing, carding, drawing, twisting, winding, warping, spinning, wefting, weaving, piecing, mending, burling picking, examining, napping or fleecing, splicing, washing and drying of fabrics in the manufacture of woolen goods (these employed 449 males and 1,951 females in 3 establishments). This sums up a total of 2,400 engaged in the above processes. (Wool sorting, washing, scouring, drying, and dyeing, as well as Cloth Cutting, Sewing, Pressing, etc., are not included in these figures).

In all places modern machine methods were present. There were no union organizations. The general attitude of the managements towards the welfare of employes appeared excellent in 6 places and fair in the remaining 1. An intelligent class of employes was engaged in 6 places, but a large percentage of ignorant workers, principally foreigners, were employed in the remaining place. Workers appeared to remain well in all of the places investigated and in most of them considerable interest was taken in the health and welfare of individuals. Health appliances consisting of artificial ventilation devices, excellent lighting systems, lunch rooms, rest rooms, and sanitary conveniences obtained in 4 places, and were better than in the usual run of factory processes in the other 3 places. Organized instructions along lines of health conservation were given in 1 place and steps were being taken in this

direction in 3 other places. There were no sick benefit organizations among the employes in any of the establishments. Very little of the work was of skilled character, but experience developed dexterity among many workers. The general construction of work quarters was hygienically good in 6 places, but only fair for many of the workers in the remaining place. Age-group estimations summed up as follows: over 45 years, 19; between 40 and 45 years, 265; under 40 years, 2071. About 25 percent of the last age-group were under 20 years of age. The workday was 9½ hours in 1 place, 9¾ hours in 2 places, and 10 hours in the remaining 4 places; the noon recess was 1 hour in 5 places, ¾ hour in 1 place, and ½ hour in the remaining 2 places.

KNITTING.— The chief health-hazards of the knitting machine rooms were as follows: (1) *dust* of a fine lint and cotton character, which contaminated the atmosphere to a nominal extent; (2) *fatigue,* due to monotonous application, continual standing and walking back and forth, and loud noises; (3) some liability to the contraction of *communicable diseases* in some places, due to the use of common towels and common drinking cups. In some places springy board walks were provided for those who were constantly on their feet, — a great advance on standing on cement floors and the like.

CARDING, COMBING, TWISTING, WINDING, WARPING AND DRAWING. — These processes were investigated in 3 large woolen mills. A limited amount of fine wool *lint* was present in the breathing atmosphere. *Cleaning,* usually dry sweeping or brushing up, was going on in nearly all places constantly. *Humidifiers* were used in one place. Quarters were sometimes poorly *lighted.* General room *ventilation* was fair to good in all places. It was much improved in one place by room exhaust fans. *Fatigue* factors were such as constant piece-work, monotonous application, prolonged standing, faulty postures, seats without back rests for certain workers, jarring proccesses, eye-strain and loud noises. The liability towards contracting *communicable diseases* was some hazard in several places, due to promiscuous spitting, the absence of cuspidors, the use of common cups and towels; also there was no medical examination of employes. Several cases of consumption were brought to the notice of the survey from among woolen mill operators.

SPINNING AND WEAVING. — (WOOLEN GOODS). — There, was less quantity but the same type of *dust* as described in the process above. Its accumulation upon the floors and elsewhere was permitted to some extent in 2 places. *Lighting* and *ventilation* was not good in some rooms. Some were also overly *warm. Fatigue* was probably the chief hazard, due to monotonous piece-work, speeding up, long periods on the feet, faulty postures, jarring processes, some eye-strain and a great amount of loud noise. The liability to contraction of *communicable diseases* was the same as described elsewhere. Humidifiers were used in one plant, but the hazard from *dampness* seemed only a nominal feature.

NAPPING AND FLEECING. — There was some *dust* contamination of the atmosphere from this process in both cotton and woolen goods. The process was partitioned off and employed very few help (men). Quarters were sometimes *warm* and noisy.

PICKING AND BURLING. — A considerable number of girls were employed at this process, the chief health-hazards of which were piece-work, some evidence of speeding up, long periods on the feet, while the hazards common to other processes which were conducted in the vicinity were also

present. The work was of quite diversified character, permitting of walking back and forth, stooping, standing upright, and reaching in all directions.

JOINING, SPLICING, AND MENDING.—The principal hazard in this process was that of fatigue which was due to hurrying piece-work, monotonous sedentary application, occasionally chairs without back-rests, faulty postures, and a certain amount of eye-strain.

WEAVING.—This process was investigated in the manufacture of blankets as well as of woolen goods. The chief hazards were *dust* from wool lint (limited) and other fibres used to form the textiles, the accumulation of the same upon the floors, some factors of *fatigue,* and the liability to contracting *communicable diseases,* all of which were about the same as described for Spinning.

CUTTING CLOTH.—In all textile and clothing establishments a certain number of employes are engaged at cloth cutting processes under certain hazards. As investigated in 10 establishments in 3 cities, there were found to be employed 313 wage-earners at the process, of whom 243 were males and 70, females. A large percentage of the employes were skilled workers. In a number of places electric cutters, capable of cutting through many layers of cloth at one operation were in use. Age-group estimations showed 147 over 40 years; and very few under the age of 20. The work was usually done in the same quarters with other processes, such as Sewing, Pressing, and stock keeping.

The chief health-hazards were textile *dust* (wool, cotton, etc.) which was in the breathing atmosphere to a fair extent in most of the establishments, particularly where the electric cutters were used. In 2 places, *lighting* was only fair, which was some feature because of the close eye work necessary. *Fatigue* was due to piece-work, constant standing, stooping postures, and eye-strain. Electric lamps without reflectors were observed in some places. The workday was from 8 to 10 hours, with a noon recess varying from ½ to 1 hour. The liability to contracting *communicable diseases* appeared negligible in 4 places, fairly so in 2 others, but present in the remaining 4, due to crowding together of workers, the use of common towels, common drinking cups, promiscuous spitting upon the floors, the absence of cuspidors, and the lack of medical supervision of workers.

WOOL SORTING.—Wool sorting was found not to be an extensive process in connection with the textile industry. In 2 large plants there were a total of 63 men so employed. Practically all were skilled workers in 1 place. There were 22 estimated as over 40 years of age. Work quarters were hygienically constructed in 1 place, but not so good in the remaining place. Other processes such as the washing, scouring, drying and turning of the wool were also present.

The principal health-hazards were (1) *dust,* composed of fine hair particles and dirt from the unwashed wool, and from which there appeared to be little means of protection. It was not of any considerable amount, however, but was fairly constantly present. Quarters were (2) very *dirty* and disordered in 1 place, where also there was considerable (3) *dampness* from the associated washing process; (4) *light* was poor in 1 place, and (5) general room *ventilation* not good, due to confinement of quarters and contaminations of the air from the wools handled, and the foul *odors;* (6) *fatigue* was a nominal hazard, due to constant standing and faulty stooped-over postures,

with a unit piece-work system, as a rule; (7) the liability to the contraction of *wool-sorters' disease* was carefully inquired into, but no evidence of the same was found either in the present or past. The wools handled were of both domestic and foreign origin. Many of the workers were informed upon the possibility of the disease from the handling of wool, but claimed that domestic wools were perfectly safe in this respect. Neither pulmonary nor skin symptoms were discovered which could be considered as suspicious of anthrax infection. On the other hand there was considerable spitting upon the floors and an absence of cuspidors, as well as the use of common drinking cups, common towels, and in 1 place, workers were very much crowded together. In the washing of the wool in soda water there was a hot, foul smelling odor present, associated with considerable steam and humidity.

CORDAGE, TWINE AND JUTE.

The various processes concerned in the manufacture of cordage, twine, rope, and in 1 instance, halters, were investigated in 5 establishments in 3 cities, where a total of 510 wage-earners were engaged, of whom 434 were males, and 76 were females. The latter were employed in Spinning, Twisting and Balling only. As the various conditions of work were somewhat similar, a general summary will be made first, after which the particular processes will be discussed.

Methods appeared to be modern in all respects in all places. There were no union organizations. The general attitude of employers toward the health and welfare of employes appeared good in 2 places, fair in 2 others, but poor in the remaining 2. A fair type of employes were engaged in 3 places. (Males were principally colored persons in 2 places.) A very ignorant and largely non-English speaking class were engaged in the remaining 2. The work was practically all unskilled, although some experience made certain workers quite adept. There were no devices which could be termed health appliances in any of the establishments, nor were there any mutual benefit associations nor organized health instructions. Washing facilities and toilets, however, were fair to good in all except one place. Bubbling fountains were present in 2 places. The general construction of work quarters was good in 2 places, fair in another, but hygienically bad in the remaining 2. The age-group estimations summed up as follows: over 40 years, 62; under 40 years, 448. Of this latter number about 20 per cent were under 20 years. The workday was 10 hours in all places, with 1 hour for a noon recess in 3 places, and ½ hour in the other 2. There was practically no over-time.

Preparation Processes.—These included opening, breaking, spreading, moistening with oil (crude and fish), drawing, combing, carding, twisting and roving to form a sliver. The fibres used were sisal and manilla hemp, jute, and chinese-jute. The work was all done by males. These processes were practically the same as far as health-hazards were concerned. The chief hazards were the excessive amount of fibre *dust* and some dirt arising from the material, which was of a fine and irritating character, and affected the skin, eyes, and breathing apparatus. It arose in clouds from some of the machines and so covered workers that it was difficult to distinguish colored from white persons. There were no mechanical devices to control this dust. New workers were particularly affected by it. It was said that only a few workers could stand it. Older workers, however, were not so bothered, but the condition of

pneumonoconiosis was certainly present. The next hazard of importance was probably *fatigue,* which was practically the same in all places, and was due to being constantly on the feet, the jar of machines, the piece-work character of the process and the loud noise. Chinese jute had a peculiar foul *odor.* *Ventilation* was poor in 3 places, and quarters quite *dark* in 2. The liability to contracting *communicable diseases* appeared to be slight in 2 places, (due to the presence of all necessary sanitary conveniences), to be a fair risk in 1 other establishment, and bad in the remaining 2, due to promiscuous spitting into the dust on the floors, the absence of cuspidors, and lack of any medical supervision. (The liability to lock-jaw infection has been noted in connection with this work abroad.) In all except 1 establishment floors and quarters were being constantly *cleaned.* The industrial inducement to *alcoholism* would appear to be considerable in this process, due to the dry, irritating effect of the lint upon the nose and throat, and the noisy monotony of the work.

The general *appearance* of the workers averaged good in 1 place, fair in 3 others, while a considerable percentage of physically sub-normal persons were employed in the remaining place. The chief *complaints* of the workers were the breathing of dust and lint, which caused coughing and sore throat, while it was said that skin rash was sometimes created by the oil and coloring matters used. Investigators reported several cases of chronic bronchitis, as well as some which were probably tuberculosis. *Comments.* — It would appear that workers could be induced to wear some form of light respirator. Exhaust hoods and latticed bases for machines are used for removing dust in these processes. Cotton worn in the ears would limit deafness and ear infections (from dust). All employes should have physical examinations at intervals, while any with a tuberculous tendency or a consumptive family history should not be allowed to work in these processes. According to Hoffman (U. S Labor Bulletin No. 79) there is an excessive death rate from consumption in rope making.

SPINNING. — This process did not differ materially from spinning in the cotton and wool textile industry. The chief hazards were the excessive amount of *dust* which pervaded the breathing atmosphere, and was composed of the same substances as above mentioned (except dirt, which was by this time separated out). The dust was also finer, but lighter. *Fatigue* here was dependent upon hurrying piece-work, considerable evidence of speeding up, constant standing, jarring, jiggling work, and excessive noise. This was so great that investigators said they could not hear themselves yell. Deafness and hoarseness were accompaniments. *Complaints* of the workers were coughing, constant standing, skin irritations, from oil and dust, and the absence of gloves. A considerable amount of unprotected machinery was observed in some places. In 1 place several workers were inordinately exposed to hemp dust from a "hog machine" used for stranding and crimping the fibre.

ROPE MAKING. — The twisting of spun twine into ropes in the "rope walk" quarters was found to employ a relatively large percentage of the workers in the cordage industry. In 1 plant about one-fifth of the employes were girls. It was entirely machine work. Lint and fibre *dust* were present in the breathing atmosphere in a fine state of subdivision, but less in amount than in the processes described above. Some piece-work prevailed, while prolonged standing, jarring and jiggling and loud noises were also present.

CORDAGE FINISHING.—This process consisted in starching and hot drying of the twine, and was done by men. The workrooms were somewhat close and also quite *warm*. Light was poor in one place.

CORDAGE "BALLING".—The running of the twine into balls created a little *dust* in the breathing atmosphere. It engaged both girls and men. Piece-work, monotony, and constant standing were features.

CORDAGE TARRING.—The submitting of twine to tar pitch was done to a limited extent by a few men. It was accompanied by the usual tar odor which was made much worse by the poor *ventilation* of the workroom and absence of a device for removing the odors and vapors. The work was also fairly *hot* for the summer season. Loud noise was the chief *fatigue* factor.

MATTRESSES.

The processes concerned in the manufacture of mattresses, and, in 1 place, of wadding, or stuffing material for shaping clothing, were investigated in 7 establishments in 5 cities, where a total of 115 wage-earners were employed at these processes exclusively, all males. (The renovating of second-hand mattresses was not investigated.) The various sub-processes were felting, filling of ticks with the prepared felt and excelsior layers, tying and finishing up the ticks. The sewing processes (done by females) did not differ from Sewing as described elsewhere, except that they were apt to breathe the dust from other processes, as well as the starch contained in the ticking.

Modern machine methods were employed in all places. There were no unions. The general attitude of employers toward the health and welfare of employes and the intelligence of types of employes appeared good in 5 places, and at least fair in the remaining 2. In 3 places workers did not appear to remain very well at the processes. Health appliances, consisting of hoods with exhaust fans, or simply room exhaust fans were present in 5 places, but in 2 of these they were not at all efficient (in one, the blower system was disjointed). There were no sick benefit associations. The construction of work quarters was good in 2 places, fair in 2 others, but hygienically bad in the remaining 3. Age-group estimations showed a total of 8 workers over 40 years of age, while about 15 per cent were under 20 years. About one-fifth of the workers were more or less skilled.

The chief hazards of the process were *dust*, composed of fine lint, cotton, hair particles, etc., which went to make up the composition of "felt" (this varied considerable in different instances). Dust was bad in 4 places, and fairly so in the remaining 3. In filling (done by forcing the prepared felt into the tick) and finishing mattresses, much dust was created by workers beating them into shape. Where excelsior was used wood dust was also added to the breathing atmosphere, but as a rule to a limited extent. One plant greatly limited the amount of dust at the felting machines by the use of a fine spray of volatile oil which it was claimed did not affect the material, while it practically inhibited the dust. An exhaust system was also present. The oil was said to be expensive, and on this account not much used elsewhere. In another plant without hoods or lint confining devices, the windows were kept shut to prevent losing some of the material by chance breezes. One or two workers in most plants were greatly exposed to dust in the rooms where the felting materials were blown out of conveyor pipes. Occasionally, young boys

were employed in this room where they breathed the dust, which was stifling. Quarters were kept *clean* in 1 place, fairly so in another, while but limited attention was given to cleaning in the remaining 5 places. The *lighting* was poor in 2 places and not very good in 1 other. Outside of the contamination of the air with the fine dust, *ventilation* was ordinarily good. Gas stoves (without outlets) were much depended upon for *heating*. The work could not be considered of a *fatiguing* nature, although piece-work and some monotony, with prolonged standing were involved. There was more or less diversity of application. The workday was 10 hours in 5 places, and 9 hours in the remaining 2. The noon recess was ½ hour in 5 places, and 1 hour in the remaining 2. The liability to contracting *communicable diseases* was a fair hazard in all places, and particularly so in 5, due to the use of common drinking cups, common towels, promiscuous spitting, the absence of cuspidors, dry sweeping, and the liability of contracting diseases from the materials handled. Washing facilities were very poor, as were also toilet arrangements in 5 establishmetns. There appeared to be no risk of *poisoning*. The industrial inducement to *alcoholism* was incited chiefly by the breathing of fine irritating dust, and in some places by the absence of adequate drinking water facilities.

The general *appearance* of workers was only fair for most of them in 3 plants, while it was said that it was hard to retain help at the felting work in one or two of the larger plants. The chief *complaints* of the workers were cotton lint which was constantly in the air, causing cough, colds, shortness of breath, pains in the chest, and smarting of the eyes. Poor ventilation was also mentioned in some places. The investigators came across several instances where it was thought workers were consumptive or at least badly in need of a physical examination to determine the presence or absence of this disease. *Comments.*—In the wadding company investigated, exhaust fans, ventilating schemes and dust collection system were placed at all points needed and appeared very efficient. Certain processes in the mattress works were similarly equipped, but there was some room for improvement in all these establishments. The suggestions above call attention to other sanitary and hygienic features needing correction to improve the healthfulness of the work. Certainly no workers predisposed to consumption should be employed in the dust producing manipulations of this industry.

FEATHER DEPARTMENT.—The grinding and renovating of feathers by machinery was very dusty work. The floors were covered with pieces of feathers and the ceiling in one place was covered an inch thick with down. In spite of this, one man was found who had been so employed for 20 years and had no complaints to make. In other places workers complained greatly of coughing. Boys filling pillows stood knee-deep in feathers in a room with windows tightly closed. It appeared that fine screens could have prevented loss of feathers due to breezes, had the windows been so provided.

PAPER.—RAG SORTING.

Rag sorting has been considered under the head of Junk, but there is in connection with the paper and roofing material industry a considerable number of employes engaged in this preparatory work, and being in large establishments, they are under somewhat different health-hazards. Our investigations covered this process in 9 establishments, where a total of 153 wage-earners

were so employed, of whom 25 were males and 128 were females. There were no unions. An ignorant, and often non-English speaking class of employes were engaged in practically all places. In about half of the places the personnel appeared to change quite frequently. The managerial attitude toward the health and welfare of this class of employes appeared good in 2 places, fair in 4 others, but quite "uninterested" in the remaining 3. There were no mechanical devices which could be termed health appliances in any establishment. Respirators were furnished in some places, but little worn. In 1 establishment employes were privileged to join a mutual benefit association. The general construction of work quarters was hygienically good in 2 places, but not so in the remaining. The age-group estimations summed up as follows: over 50 years, 1; between 40 and 50 years, 22; under 40 years, 130. About 10 per cent of the latter were under 20 years.

The chief hazards of this process were (1) the breathing of *dust,* which was of practically every imaginable character, depending upon the source of the rags which were being sorted. It was made much worse by the presence of cutting, grinding, and beating machines. The work was necessarily (2) *dirty,* and quarters were kept hardly more cleanly than already described for those working in junk shops. (3) *Lighting* was inefficient in 3 places, and particularly so in 1. The general (4) *ventilation* of quarters was good in 1 place, fair in 2 others, and poor in the remaining 6, due to stagnation of the air, its contamination and pollution with dusts and odors, and the absence of ventilating apparatus which was much needed in most places. Quarters, however, were usually sufficiently (5) *heated* (not always), although in this respect (6) the inactive character of the work, combined with irregular heating was a complaint in at least 3 establishments. (7) *Fatigue* was some hazard in all places, due chiefly to constant application under the tension of piece-work. Some evidences of speeding up were noted, while many of the workers asumed faulty, stooping postures, and positions of the feet easily productive of flat foot. Chairs with back rests were provided in 1 place. The workday was 9 hours in 2 places, 10 hours in 6 places, and 12 hours in the remaining place. The noon recess was 1 hour in 3 places, ½ hour in 5 places, while in 1 of the 9-hour-a-day places there was no noon recess taken. One hour was allowed in the 12-hour-a-day establishment. One place also had a night shift of men, of 13 hours duration. The liability (8) of contracting *communicable diseases* was great in all places, due not only to the handling of unsterilized or undisinfected rags and materials (see under Junk), but also to the use of common drinking cups, common towels, very poor washing facilities and toilet arrangements (especially for females in a number of places), spitting upon the floors, the absence of cuspidors, the lack of gloves, and, as elsewhere, of any medical supervision. The industrial inducement (9) to *stimulatism* was considerable for all of these workers, due to the foul nature of the work, the dust, and the depressing influences of long hours. The question of the propriety of both sexes working together in such a process has been mentioned under Junk.

The general *appearance* of this class of workers was no better than fair. The chief *complaints* made (as elsewhere it was difficult to get any of these employes to answer questions) were the breathing of dust, irritation of the nose and throat, and coughing, due to the same. Many workers "claimed" not to be affected by it. Women were frequently heard coughing. Investigators reported a few cases who were probably suffering from consumption.

Comments.—The general improvement of washing and toilet facilities, the supplying of gloves and of respirators (which workers should be compelled to use when handling unusually dirty and dusty rags), the separation of men from women, and a medical supervision are all necessary to improve the healthfulness of this trade process.

RAG CUTTING, GRINDING, BEATING AND SHAKING.—These were machine processes and attended to by men, although women at rag sorting were sometimes in the vicinity. The dirtiest and cheapest qualities of rags were used for roofing materials. The dust created was usually terrible. There were no protection devices of any sort in one place, and in most of the other hoods and exhaust were mere makeshifts which were little effective in removing the dust. Respirators where present were principally "worn around the neck." In 1 place green window shades were being ground up and the workers were covered with green dust. It was admitted that help was hard to keep. *Fatigue* was a fair hazard, due to long hours at monotonous application, constant standing, faulty postures, jarring work, and loud noises from the machines. The general *ventilation, light* and *sanitary conveniences* were about the same as for those in sorting. The liability to contracting *communicable diseases* was greater because of the greater amount of dust, and, being all males, the greater amount of spitting about the floors. *Comments.*—Good hoods with proper exhausts, cuspidors and proper washing facilities are the chief needs. Perhaps oil or water spraying might be utilized to some extent to limit the dust.

PAPER.—BEATING.

Many workers, espceially females in the paper industry were simply engaged in General Factory Processes.

The beating process consists in adding water to wood pulp, straw, rags or paper clippings(sometimes to mixtures of these), in a machine called a beater, which is equipped with blades to help in the maceration of the material. Alum and rosin are also added to give tenacity or "size" to the future paper. Bleaching substances and anilin dyes may or may not be added.

As investigated in 13 establishments in 6 cities, there were 377 men employed about the "beaters". About the same methods appeared to be in use in all places. There were no union organizations. The general attitude of the managements in regard to the health and welfare of employes appeared good in 8 establishments, air in 3 others, but quite indifferent in the remaining 2. The same proportions obtained in respect to type of employes engaged. In at least 4 establishments workers appeared to be difficult to retain at this process. Three plants were equipped with shower baths. In 2 establishments there were mutual benefit associations, and in 1, some organized instruction was given in matters of health conservation. About ⅓ of the workers were semi-skilled, the balance being unskilled labor. The general construction of work quarters was hygienically good in 6 instances, but not so in the remaining 7. Age-group estimations summed up as follows: over 40 years, 19; under 40 years, 358. Of this latter group a small percentage were under 20 years of age.

The process itself was unaccompanied by *dust,* but the emptying of barrels of alum and rosin and the shoveling of the same created some very objectionable dust. In 6 places dust was undoubtedly a hazard to some, and particularly so in 3 of these. There was an absence of efficient mechanical

means of handling it. Quarters were allowed to be filled up with *dirt* and waste accumulations in 5 establishments. The work was necessarily of a wet and sloppy character, so that *dampness* was a hazard in all places, and particularly so in 9 of them. It was due to water upon the floors, occasionally to steam, and to the humidity of the workrooms. Employes in many establishments were aecustomed to going barefooted. This, eombined with walking upon cold, eement floors, in drafty rooms was very detrimental to health. It was claimed that boots were objectionable, caused sore feet, etc., but why this should be any more so than in rubber works, breweries, etc., is not clear. In 4 establishments *lighting* was inefficient, so that this hazard was also added to dampness. Torches were used in one plant. The general *ventilation* of workrooms appeared good in 6 places, fair in 3 more, but poor in the remaining 4, due to stagnation of the atmosphere and its pollution with vapors arising from the process. In 3 establishments *heat* was some hazard, and particularly so in 1, due to steam and close confinement. The question of *fatigue* was principally one of long hours as there appeared to be no laborious work of continuous character. (See under the next process.) Thc liability to contracting *communicable diseases* appeared negligible in 2 places, fairly so in 3 or 4 more, but considerable in the remaining 7 or 8. The chief reasons for this were the use of common drinking cups, poor washing facilities (sometimes none present) and closets, the handling of materials (rags, paper) which might carry infection, and in some places the use of polluted canal water for various proeesses, which wet the quarters where workers went barefooted, etc. The risk of industrial *poisoning* appeared a limited hazard in all places, due to alum dust, rosin dust (while handling) and escaping chlorine fumes from bleaching processes. In addition, anilin dyes were occasionally used, but with little apparent hazard. The industrial inducement to *alcoholism* was chiefly dependent upon the depressing influence of dampness, wet and sloppy work, irritating dusts and fumcs, and the weariness of long hours.

The physical *appearance* of workers was about average. A number of men who were under par, and probably suffering from chronic diseases, were seen. There were very frequent *complaints* of catching cold, and of rheumatism, while a few complained of irritations of the nose, throat, serotum, groins and skin, from alum dust, and of other affections from the poisons used. Our investigators reported several cases of undoubted tuberculosis, and 1 or 2 of dermatitis. *Comments.*—Outside of improvements in sanitary conveniences in a number of places, the most objectionable feature was the habit of the workers in going about barefooted. Certainly it would appear that proper boots and aprons should be provided; also gloves and respirators to be put on when neeessary to be exposed to dusts or solutions. Medieal supervision would greatly reduce sickness and hazards.

PAPER.—MACHINE ROLLING.

After the pulp has been prepared in the beater room and has been screened to remove any lumps which may be present, it is put through machines, which roll the pulp into sheets and dry the same. This process was investigated in 13 establishments and was found to engage 372 wage-earners, all males. The process was very much the same in all placcs, whether paper or roofing material was being made. There were no unions. The general attitude

toward the health and welfare of employes, the type of employes, and the retention at the process did not differ materialy from what has already been said for those in the beater room. In 6 of the establishments there were hoods and exhaust systems placed over the machines which quite effectively removed the steam and heat escaping from same. They were, however, entirely absent in the remaining 7 establishments. The general construction of work quarters was good in 5 places, fair in 2 others, but not good in the remaining 6. In only 1 place were there other processes present. Here the Sorting of Rags was being done by females. The age-group estimations showed 27 over 40 years; and 345 under 40, with a relatively small percentage under 20 years.

Dust was no feature of the process. Quarters were kept *clean* and orderly in 7 establishments, fairly so in another, and not so in the remaining 5. As in the beater room, this work was accompanied with a great deal of water upon the floors, steam in the air, and general *dampness* of the quarters. In but 1 place was this not so, while in 9 places it constituted a marked hazard to health. Quarters were well *lighted* in 7 establishments, usually by skylights, saw-tooth roofs, etc., and in a number of places amber glass was used, which gave a very pleasant effect to the workroom. In the remaining 6 establishments, light was not good, and particularly so in 1, where it was difficult to see about the room, and very dangerous on account of exposed machinery. The general *ventilation* of quarters was good in 6 establishments, fairly so in 4 more, but not so in the remaining 3, due to stagnation of the atmosphere, contamination with .steam and vapors from the process, both of which were the result of the absence of exhaust hoods and means of changing the air. *Heat* is a necessary feature of the process, but because of excellent local ventilation about the hot rolls, it was no hazard in 3 establishments and but a nominal hazard in 5 others, but the remaining 5 places were unduly hot. In most of these latter, also, there were but limited facilities for washing. On the other hand, a number of the better equipped establishments had shower baths at hand. The liability to *chilling* was present in a number of places, due to the fact that the employes preferred to work in their bare feet. The work itself was not at all *fatiguing* and there appeared to be plenty of variation. Unusually long hours, however, were present in many places. The workday was 10 hours in 2 places, 11 hours in 2 places, 12 hours in 2 places, 12½ hours in 1 place, and from 11 to 13 hours in the remaining 6 places, the latter influenced by the double work shift for 24 hours. These shifts changed from day work to night work and *vice versa* once a week. This frequent change was very much objected to by numbers of workers who stated that they did not get used to sleeping properly before it was necessary to again change the work shift. Many of them stated they would rather work continuously nights or days for a much longer period. The noon recess was 1 hour in 1 place, ½ hour in 4 places, "as desired" in 4 places, absent in 2 places (and not reported upon in the remaining 2). The liability to the contraction of *communicable diseases* appeared practically negligible in 3 places, fairly so in 3 others, but bad in the remaining 7, the latter due to the same conditions as described under the beating process. The liability to *poisoning* seemed very remote. The industrial inducement to *alcoholism* was rather less than that described for "beating", as dust and poisons were absent in this process.

The general *appearance* of workers was the same as stated for the beaters. The only *complaints* made outside of the irregularity and length of

working hours were the water, steam and humidity in some of the plants, with the consequent subjection to rheumatism, coughs and colds. Investigators reported 1 case of acute inflammatory rheumatism. *Comments.* — (See under the preceding process.)

MIXING AND MANUFACTURING OF CHEMICALS. — There were hazards from irritating dusts, and fumes and smoke, in the preparation of bleaching solutions (chlorine), sizing mixtures (alum, soda ash, rosin), neutralizers (lime), saturating compounds (petroleum, asphaltum, tar, smoke, etc.) and in sodium hydroxide recovery processes (sodium carbonate, lime), — most of which were the cause of various skin, respiratory and digestive complaints. Only a comparatively few workers were so employed. (See Mixing Chemicals elsewhere.)

OIL REFINING.

The refining of petroleum was investigated in 4 establishments, and linseed oil in 1 establishment. The products of manufacture consisted of petrol naphtha (and gasoline), illuminating oils, lubricating oils, greases, paraffin, tar and coke, and, in the linseed works, boiled oil. The large majority of the workers were simply laborers engaged in and about the distilling and refining works. In even the largest plants but a few skilled men were employed. In the 5 establishments there were 251 wage-earners, all males, employed immediately in the processes described below. Practically everything was handled by the most modern devices, whereby most materials were confined and moved from place to place by means of pumps and piping, so that workers had little to do outside of watching the machinery, and the opening, cleaning and closing of stills and tanks. There were no unions. The general interest of the managements in the welfare of employes appeared good in 2 places and at least fair in the remaining 3. While a certain percentage of foreigners were found who could not speak English, practically all workers were of an intelligent type, many were old employes, and retention appeared good at all places. In addition to the various forms of confining apparatus, hoods and exhausts were generally present where needed. There were no mutual benefit asociations, although a pension plan existed in 3 of the places. There were no instructions given along the lines of conservation of health. The general construction of buildings was hygienically good in 2 places, fair in 2 others, but poor in the remaining establishment. In this respect a large percentage of the operations were simply outdoor in character. There were usually separate buildings or places for different operations. Age-group estimations for those concerned in the process described showed 64 over 40 years, and 187 under 40 years, of whom about 5 to 10 per cent were under 20 years.

General health-hazards were limited. Many persons were exposed to the inclemencies of the weather; washing facilities and closets were very poor in 2 places, and, in some quarters, in a third place; there were good first-aid and hospital arrangements present in the larger places; promiscuous *spitting* (indoors), and the absence of cuspidors were general observations. *Long hours* prevailed for numbers of workers in all places. A common arrangement was an 11-hour day and 13-hour night shift. Noon recess periods varied from ½ to 1 hour. There were plenty of opportunities for rest periods for most workers, however, in the processes described below.

RECEIVING THE CRUDE PRODUCTS.—These were received at the works usually by pipe lines. There was an *odor* of hydrocarbons (methane?) and of hydrogen sulphide present in some places, but not hazardous except when leaks occurred. It was reported that cases of *sore eyes*, due to the products, were not infrequent.

DISTILLING, REFINING AND SPECIAL PROCESSES.—These include the purification of the petroleum with sulphuric acid and its neutralization with caustic soda; later decolorization of oils and greases with Fuller's earth, etc., and deodorizing with hydrochloric acid and calcium chloride. Fumes, apparently of hydrogen sulphide, sulphur dioxide, and sprays of sulphuric acid were noted. *Ventilation* was poor in some of these quarters so that the men complained of the effects of these fumes. There was a little risk to men who tested the acid. There was some *dampness* due to steam from open pans of sulphuric acid. Acid fumes were also very irritating in tar recovering, although the product was turned into large (open) vats out-of-doors. In one place hoods were provided. In some places there were no fans and there was considerable risk when retorts were opened and residues removed, especially due to sulphur dioxide. Lead oxide was among the substances added to the oil, being shoveled into the open vats. This was only done, however, at intervals. *Dust* was reported bad in a desulphurizing process using a mixture of copper, lead and iron oxides, while *heat* was considerable from washing of the copper sulphide formed to recover the copper oxide. In the saponification of oil with lime water there was a little dampness, due to water, and considerable *noise* from machinery. LEAD BURNERS who repaired lead-lined tanks or vats ran the risk of *lead poisoning* described elsewhere.

FILTERING AND PRESSING.—The residues were here separated into heavy oils, greases and paraffin. A temperature of 50° F. was maintained in some of the operations. The men worked in this *"cold room"* only about three hours on a shift, but had risk from alternation with the warmer outdoors. Here paraffin was obtained by big presses. It was conveyed to a sweating chamber, where it was heated and filtered. It was all machine work and the men did not come very much into contact with the products. It may be said that the development of *paraffin cancer* has been found to occur in the handlers of the crude heavy products as well as considerable dermatitis and acne. There was considerable *odor* in connection with this work, as well as some *dampness* and humidity. Ammonia *fumes* in limited amount were noticeable in the engine room of the cooling plant. The boiling down of wool greases to add to lubricating oils created a vile *stench*. In the case of linseed oil, the building was poorly *lighted* and the floors covered with *accumulations*. The grinding of the flaxseed was very *dusty*, as was also the sacking of the flaxseed meal.

MANUFACTURE OF BOILED OIL.—In 1 plant this was done only at intervals and consisted in the mixing of litharge, white lead and manganese with linseed oil, the kettle being placed out-of-doors under a roof. (See also Oilcloth and Linoleum Manufacture.)

CHEMICALS.

The manufacture of chemicals was only partly investigated in the state. The great variability of the products would make it necessary to consider each establishment almost by itself as far as the risk to poisoning is concerned.

The intention here is to limit the discussion to those firms truely engaged in the *manufacturing* of chemical ingredients and not in the *mixing* of chemical ingredients, which has been taken up elsewhere. In 6 establishments investigated there were a total of 1,375 employes. The companies ranged in number of employes from 8 and 18 to 550. Of these wage-earners, however, only 430 (all males) were engaged in the processes themselves. The working conditions as concern these process-workers were separated out and are here described.

In 3 of the establishments modern methods and fairly modern conditions of work appeared to exist, but for the other 3 this could not be said. There were no unions in any of the establishments. The general interest in the health and welfare of employes appeared good in 3 establishments and poor in the remaining 3. A large percentage of foreigners, usually non-English-speaking were employed in all of the establishments, but the general type was good in 2 places. Workers appeared to remain fairly well in 3 of the places, while there was a continual change in the personnel in the remaining 3. Devices which might be termed health appliances were practically absent in 4 of the establishments, while the remaining 2 were, at the time of inspections, either equipped or making renovations to meet the requirements of the law for the prevention of lead poisoning, the specifications of which allow until October 1, 1915, to be completely met. In 2 establishments instructions were given concerning the danger to health from the chemicals involved, and the rules of personal hygiene to be observed, while health placards were posted in 3 plants. There were no mutual benefit associations in connection with any of the plants. The general construction of work quarters was fair to good in 4 establishments, but hygienically bad in the remaining 2. In the smaller places, and to some extent in the larger, workers in 1 process were exposed to the hazards present in another. Very little skilled work was required of wage-earners. Age-group estimations summed up as follows: over 40 years, 69; under 40 years, 361. Of the latter age-group about 10 per cent were under 20 years. — The workday was three 8-hour shifts in 1 establishment, 8 to 9 hours in another, 10 hours in 3 others, and 12 hours in another (large) establishment. The noon recess was ½ hour in 3 places, 1 hour in another, "odd times" in another, and "no time" in the remaining place. The health-hazards in connection with the various manufacturing processes are given in brief below:

POTASSIUM FERROCYANIDE. — Light and ventilation were from the ceiling only. The floor was chiefly of *dirt,* with some rough boarding. The furnaces, tanks and all processes were in the same work area. There was inadequate *ventilation* and *light,* and some parts were very damp. Sanitary arrangements were primitive. The only *heating* arrangements were the furnaces themselves. *Spitting* was promiscuous. Scrap leather was burned with potash and iron to furnish the nitrogen. There was considerable *odor* of ammonia fumes and hydrogen sulphide. Some smoke was also present. In spite of these hazards the workers all denied sickness and looked healthy. They had been present from one month to several years.

SODIUM CARBONATE AND BICARBONATE. — These processes were investigated in 2 establishments. In the smaller place the crystallizing room was located in a *dark, cool,* damp basement, which was apparently never *cleaned* and *doors* were very prevalent. The evaporation quarters on the second floor were somewhat better, although *ventilation* provisions were poor and the room was *warm.* Fortunately the workers were not engaged in any

one department continuously. On the other hand, they were subject to the effects of going from the cool basement to the warm quarters above. — In the large establishment the engine room was not separated from the process (Solvay) and was extremely *warm.* The floors were *damp* through being continually wet. There was considerable *dust* of the bicarbonate in the air, quarters were *dark* through the insufficiency of windows, and the *air* contaminated with ammonia and hydrogen sulphide fumes to a fair extent, while *heat* (the places were visited in the summer season) was intense. — The sodium carbonate furnace quarters were *hot* and *dusty,* the dust created especially by men shoveling the bicarbonate. Closets were in outbuildings and men experienced great variations in *temperature* (according to the season) in getting to them. The closets themselves were modern and clean. Washing facilities did not include shower baths, and for most workers only cold water was available.

WHITING. — The grinding up of calcium carbonate to make "whiting" was a very *dusty* process and everything, including the men, was covered with dust.

LIME BURNING. — Lime was burned to secure the carbon dioxide from the kilns for use in the Solvay process. Conditions were better than described for Lime Burning elsewhere, because the gas was recovered.

LIME SLAKING. — The quarters were *hot* and *wet,* but risk of poisoning seemed negligible.

SODIUM HYDROXIDE. — The quarters were *hot,* the floor *wet* and the atmosphere *humid.* It was said that in the winter one could not see across the room on acount of escaping steam. In the quarters where the caustic soda was ground up and packed into large cans, men wore gloves and gauze hoods over the head, but this protection was not sufficient. The *dust* and *fumes* were bad. The men also suffered from frequent burns. It appeared to be a dangerous occupation. Goggles were about to be supplied. The men had good washing facilities and closets.

LIME RECOVERY. — The heating, drying, grinding and sacking of used lime, while it employed but few men, was in a room which was extremely *hot* and *dusty.*

CALCIUM CHLORIDE. — There were no important health-hazards so far as could be determined in this process.

WHITE LEAD AND LEAD OXIDES. — The old Dutch process of making white lead (see U. S. Labor Bulletin No. 95) exists in 2 large establishments in the state, both of which are covered by the Law for the Prevention of Occupational Diseases with Special Reference to Lead Poisoning, which was passed by the Legislature of 1913. As the exact character of precautions and health appliances are specified in this enactment, and as investigations showed that conditions in the one were equal to, if not in advance of the law, and that in the other they were being gradually adhered to, a discussion of the various health-hazards found will be omitted. To the Industrial Commission of the State has been given the enforcement of the statutory provisions, and the Commission was seeing to the execution of orders during the course of the Board of Health survey. The reporting of occupational diseases to the State Board of Health is also required by the examining physicians required to be in attendance at these works. During the course of the survey there was a total of 29 cases of *lead poisoning* reported from these two works. Most

of these were first attacks, and had been discovered by the examining physician before they reached a degree of marked severity. A considerable number of them, however, were severe hospital cases, one, at least, resulting fatally. As is the rule in this industry everywhere, the casual workers suffered from acute lead poisoning probably five or six times more often than steady employes. (The State Board of Health will supply a copy of "The Laws of Ohio, Relating to Occupational Diseases and Industrial Hygiene," which contains the above mentioned law and others, upon receipt of a two-cent stamp for postage. It is to be regretted that the "lead law" covers only the *manufacture* of certain lead compounds and really applies to only 2 establishments in the state, since the subsequent handling of the lead ingredients in all manner of industries and processes is, in many instances, just as dangerous to the workers as is their manufacture.)

SULPHURIC ACID.—Reports are at hand from 2 establishments. From one of these several cases of *lead poisoning* have been reported in the crushing and roasting of ores, as well as complaints from the vicinity on account of the escaping *fumes*. A company physician was put in charge and hazards appear to be well in hand. In the other place there was a great deal of *dust* from the roasting of the ores, no control of which was attempted, although workers were supplied with respirators and goggles. It was stated that there was great difficulty in retaining help at the process. In the nitrating quarters there were some fumes of sulphur dioxide and nitrous oxide, more prevalent at times than others, but the workers made no complaints. All sanitary conveniences and drinking water facilities were very poor in this place.

AMMONIUM CHLORIDE.—Coal-gas liquor was used for the source of ammonia, from which there was considerable emanation of hydrogen sulphide and other *fumes*. These were said to be much worse at times and caused complaint of headache and nausea.

ZINC CHLORIDE.—One of the two fusing tanks was not well ventilated, and allowed *fumes* of hydrochloric acid to escape which were irritating to the throat and eyes. Severe burns were said to occur occasionally, which were difficult to heal.

GRINDING ORES.—The mill quarters were very *dusty* and no special provisions were made for *ventilation*.

LEAD BURNINGS.—In the various lead chambers and towers in the manufacture of sulphuric acid were employed a few lead burners whose duty it is to repair the great lead-lined chambers and conduits. One case of lead poisoning was reported in a lead burner from one of these chemical works, as well as other hearsay cases. (See Lead Burning under Soldering.)

MATCHES.

It is not intended to go into the details of the industrial hygiene of the three match factories investigated in the state, since these have been effectively covered in the report made by Dr. John B. Andrews, and contained in U. S. Labor Bulletin No. 86. According to this report, the Ohio factories, with the exception of one small place in which conditions were fair, were models even before the passage of the national enactment prohibiting the manufacture of these lucifer matches after July 1st, 1913. One of these plants is the largest in the United States. Our investigators found conditions even better at this time

than given in the above report. At present the various processes have practically no other hazards than those of general factory work, while the employes were under much better conditions of work and health supervision than has been stated for employes in General Factory Processes. We note below such hazards as were observed:

MIXING INGREDIENTS. — This process was found to be accompanied with *steam* and *dampness,* and in some instances the breathing of pulverized glass *dust,* no respirators being worn when shoveling materials. Anilin dyes, potassium chlorate, potassium dichromate, and rosin, were the principal dusts concerned. There was an *odor* of hydrogen sulphide gas when the cans of sesquisulphide of phosphorus were opened, and also during the cleaning or from paste on composition receptacles. This was a source of some complaint in the neighborhood.

GLASS GRINDING. — This was work done only at intervals, and created a great deal of *dust.* However, local exhausts took care of the most of it, while respirators were furnished, as well as goggles, but insistence upon their use was not enforced in 1 establishment.

THE MATCH MAKING PROCESS. — This employed the vast majority of workers. It was apparently free from hazards with the exception of some quarters in an old type of building which were *hot* and rather *dark,* and only fairly well *ventilated.* Two establishments had most of the quarters equipped with an air-conditioning system. On the day in which investigations were made in 1 place the temperature was 80° outside, but was being maintained at 70° within.

Comments. — While piece-work was the rule, and monotonous application, sometimes in sedentary or inactive work, the general conditions of work were excellent, and speeding up was not apparently resorted to. Industrial health-hazards appeared practically negligible.

EXPLOSIVES AND AMMUNITION.

The manufacture of explosives and ammuition, including cartridges, caps, electric fuses, blasting powder, sporting powder, and nitroglycerine was investigated in 7 establishments located in 6 vicinities. The actual number employed at the processes below described was 303 wage-earners, of whom 51 were females. The balance were employd in various auxiliary processes. The females (included) were all employed in 1 plant in the loading of cartridges (females were also employed in other departments in this plant). The 4 plants which made blasting powder covered large areas of ground with widely separated small buildings in each of which but 2 or 3 men were employed. All of these plants were excellently equipped with washing facilities and men (at powder mills especially) were required to bathe daily at the completion of work. There were no unions. The general attitude toward workers' welfare seemed good in all places. An intelligent class of workers was employed in all the processes in 2 places, while a considerable percentage of ignorant, and, in some instances, non-English-speaking foreigners were employed in other places. Workers appeared to remain well at the processes. There were no sick benefit organizations, although various pension arrangements to widows and dependents in case of accidents to workers were in vogue previous to the State Compensation Act. Age-group estimations for the processes concerned

showed 70 over 40 years, and 233 under 40 years, of whom a considerable number (of the females especially) were under 20 years. The workday was 9 hours in 3 places, 10 hours in 3 others, while work was done only at intervals in the nitroglycerin establishment. The noon recess was 1 hour in 3 places and ½ hour in the other 3. The general appearance of workers was fair to good in the various processes in 4 places, but a considerable number of unhealthy looking men were found in some of the processes in the remaining 2 places.

BLASTING POWDER GRINDING.—This powder, composed of charcoal, sulphur and salt peter, afterward glazed with *lead sulphide,* required but a few men in the grinding rooms. Some of these complained that the nitrate caused headaches and dizzy feelings at times. The work was *dusty,* somewhat *monotonous,* and was accompanied with considerable *noise.* The grinding of cakes of finished powder was done in isolated places, the workmen being provided with small sheds, where they stayed while the grinding was going on, on account of the danger of explosion. The pulverizing of charcoal was exceedingly *dusty* work and *complaints* of bronchitis were made. Some of the workers, however, had been employed a long time at this process. In one plant the grinders for nitrates were all enclosed so that the workers were absolutely protected.

POWDER MILLS.—The mills are similar to the glaze grinding mills in potteries. A charge is put into the mill consisting of the proper proportions of sulphur, sodium nitrate and charcoal and it is the duty of the 2 men in charge of each house to see that the charge does not work out from under the grinding wheels, otherwise the wheel may come in contact with the base and form a spark. Water is thrown on continually to keep the charge cool. Here is where explosions usually occur. In some places workers divided the day into two 12-hour shifts. The workers were provided with baths which they were compelled to use daily and also to change clothes daily. Health-hazards appeared quite negligible, but the work was so *dirty* that in the neighborhood the workers were called "black men."

PRESSROOMS.—Separate small buildings were used where the pulverized charge was pressed into flat cakes by hand presses or by large machine presses. The latter caused considerable *dust* from shoveling powder into the presses. The cakes were again powdered up, after which they went to a graining machine, or corning mill.

CORNING MILLS.—These mills reduce the powder to the proper sized grains, the work being somewhat *dusty.* Workers were equipped with small sheds outside where they spent most of their time, the machinery being controlled by electricity.

GLAZING POWDER.—The glazing of the grains of powder was done by putting a dipper full of lead sulphide, and sometimes graphite, into a large tumbling machine, which brought the grains in contact with the glaze. The risk from *poisoning* seemed negligible. Non-English-speaking workers were largely employed, some of whom had bad teeth, but were without other symptoms suggestive of lead poisoning.

SEPARATING, WEIGHING AND PACKING.—The grains of blasting powder were separated according to sizes, an average size being about that of a peanut kernel, and about the same shape. These were weighed and packed into cans. There appeared to be no peculiar health-hazards.

CARTRIDGES.—FELT AND WAD MAKING.—Cow-hair was run through carding machine, the large sheets of loose hair mat being next run through heated rollers and then placed in hydraulic presses which produced the compact pads of felt, such as one is accustomed to seeing. Other machines stamped out wads of the proper size for cartridges. The work had a peculiar foul *odor* of hot and *steamy* character, due to the dirty cow-hair. Many of the men were stripped to the waist, and some of them in bare feet.

METALLIC CARTRIDGE MAKING.—The copper and brass shells are received as small tubes, blind at one end, and are annealed, washed in tumblers of dilute soda solution, drawn, and annealed again,—the process being repeated until they are the proper size and shape. The work was *hot, wet,* and humid, and employed a large number of workers (not included in the figures above given).

CARTRIDGES.—LEAD ROOM.—Lead is heated in pots, run into hydraulic presses and forced out through holes into rods or wire, which are wound on spools and later cut into proper lengths and shaped for the slug or bullet to be produced. The work was practically all mechanical, and, even in packing the bullets subsequently, the girls did not touch the lead. Also, they were all instructed to wash carefully before eating and had plenty of good wash places provided with hot and cold water. The men in the lead-pot quarters and wire room appeared in little danger of lead *poisoning.*

PAPER SHELL LOADING.—The assembled shells were placed in a hopper where they passed into a machine which injected the powder, inserted the priming caps, shot, and wads, and crimped the shell all in one operation. The shells were packed on a floor below by girls, seated in well *lighted* rooms upon chairs with back rests, and room *ventilation* promoted by overhead belt fans.

PAPER SHELL MAKING.—Paper was rolled into tubes by machinery. It was waterproofed in hot paraffin in a separate room, which was *hot* and *steamy.* The assembling with brass caps was all done by machinery operated mostly by girls. Their working conditions were excellent throughout.

METALLIC LOADING AND PACKING.—The inserting of bullets into shells after the powder had been inserted, either by hand or by machine, was a mechanical process, girls operating the machines under excellent working conditions. The packing of cartridges into boxes was also entirely mechanical.

FULMINATE PRIMING CAPS.—Here fulminate of mercury was used, but only one man was concerned in the process, who was thoroughly skilled and realized the danger, both as to explosion and as to *poisoning.* The other workers were at helping processes.

MANUFACTURE OF CAPS AND ELECTRIC FUSES.—All workers were in excellent working quarters, each department being in a separate brick building in the midst of beautiful lawns. The processes of concern were (1) the spinning of white cotton upon copper wire to be used for insulation,—there was some *noise;* (2) bridging room, where the soldering of platinum wire across points and running sulphur into molds around the points was done by girls,—hazards appeared to be negligible; (3) tarring of covered wire,—*hot* and *humid* work.

NITROGLYCERINE MANUFACTURE.—This appears to be done very limitedly. One concern, which also operated in 2 or 3 places outside of the state, had practically all the work done by 1 or 2 men who were skilled. These

worked only occasionally. Helpers, it was said, occasionally complained of headache and a *feeling* of distension in the stomach, and a flushing of the face. Some, also, could not stand the *odor.* Needless to say, the plant was well isolated, being 2½ miles from the neighboring town.

FERTILIZERS AND GLUE.

While all processes of this industry may be divided into the manufacture of chemicals, the mixing of chemicals, refining of oil and grease, etc., it is well to consider the general characteristics of the business in total. Ten plants were investigated in 4 city vicinities, where 568 wage-earners were engaged at the time of inspection, all males with the exception of 10 girls who were working in a glue-evaporating department. Five of the plants made fertilizers from the carcasses, hoofs, horns, hair (wool), bones and blood of animals (the hides usually being removed and sent to tanneries), while nearly all utilized phosphatic minerals (superphosphates), which they treated with sulphuric acid to convert them into acid phosphates. Mixed manures and special manures were all produced, in which various nitrogenous substances were used. One firm was in the "degreasing tankage" business for fertilizers, solely, using gasoline for extractive purpose. Glue and gelatin were by-products in some of the rendering works.

Various mechanical processes were in use in all except 2 places where rather crude devices appeared to be present. There were no unions. The general type of employes was a very inferior class of workers, indeed described by one employer as "all bums." A very large percentage of non-English-speaking immigrants were also employed. Also numbers of negroes. It seemed to be the rule that very few persons remained in the different processes or even at the establishment longer than a few weeks or a few months. The general interest in employes' health and welfare appeared fair to good in 6 establishments, but quite indifferent in the remaining 4. In 5 establishments hoods or exhausts were present over some of the mixers to limit the exposure to dust and fumes, and in one (a large plant) storage tanks were well enclosed. With these exceptions there were few devices which could be called health appliances in any of the plants. Two places were also well equipped with good toilets, shower baths, lockers, change rooms, hot and cold water and soap. Sanitary conveniences were fearfully bad in the most of the remaining plants. In no establishments were there any mutual benefit associations or organized effort at instructing the workers in hygiene or even in the proper use of the shower baths, respirators, etc. The general construction of the plants from a health point of view appeared good for practically all departments in 3 places, fairly so in 2 others, and not so in the remaining 5. Age-group estimations showed 68 over 40 years, with 500 under that age, about 10% of whom were under 20 years. There was not much intermingling of processes. The summer and winter were said to be the dull seasons. During busy seasons the number of employes might be increased 1,000%.

Dust was a chief hazard of the industry. It was usually of corrosive character and very harmful. It was produced in the grinding machines of both natural and artificial manures, manipulating mixers, and, especially, sacking processes. It was often excessive in the breathing atmosphere and composed of basic slag, phosphate rock (superphosphates), acid phosphates, gypsum,

quick lime, potash, ammonium sulphate and phosphate, cyanamide, bone dust, dried organic tankage, etc. In a limited number hoods and exhausts took care of some of the dust, and in 1 plant trucks to be filled were entirely enclosed during the process of filling, and pulled out from the enclosure after the dust had subsided. This also avoided the need of digging out the material with spades, as was the usual custom. Dirt and disorder characterized all except 1 of the establishments. It is is to be recognized, of course, that *cleanliness* is a difficult matter in this business. However, very little attempt appeared to be made to clean up quarters in most of the places. In 4 places (cooking carcasses, tankage, glue extracting and evaporation) *dampness* was a feature, where it was due to water or escape of steam. The construction of some of the buildings also permitted of weather exposure. Certain quarters where workmen were required to be were *dark* in 6 places, and especially so in 3 of them. The general *ventilation* of work quarters could not be said to be good throughout for any place, since the air was more or less odoriferous or contaminated with dust, fumes and steam (as given under *dust* and *poisons*). There was not much hazard from *heat*. Half of the establishments were without means of heating for the winter (the dull season). Workers, however, were not engaged in sedentary processes or in places where they could not protect themselves by proper clothing. The work could not be said to be *fatiguing*, although some features of it were laborious, as in the collecting pits and sacking departments. The workday was 9 hours in 1 place, 10 hours in 9 places (except that "degreasing" crews worked in two 12-hour shifts in 1 place). The noon recess was ¾ hour in 2 places, and ½ hour in the remaining. An A. M. lunch was occasionally observed which was dangerous because no time was taken to wash up. The liability to the contraction of *communicable diseases* was great in all of the rendering plants, particularly the flaying or skinning rooms, due to the nature of the materials worked upon and the presence of swarms of flies. It would, however, take a more intensive study to determine to what extent the diseases of animals and the presence of infectious germs occurred among the workers. Malignant pustule (anthrax), glanders, gas-bacillus infection, erysipelas, virulent suppurations, "butcher's wart," typhoid fever and the spread of foot-and-mouth disease by flies were the pestilences of hazard in the rendering works. These workers were probably more exposed to such disease hazards than in the Tanning industry or any other industry investigated. In 8 of the plants, however, there was every opportunity for contracting the commoner (human) communicable diseases, due to the promiscuous spitting into dust heaps and dirt accumulations, the absence of cuspidors, the use of common drinking vessels, the absence or great inadequacy of washing facilities and the primitive types of closets provided. In many instances these consisted simply of privies which were moved from place to place over the grounds, entirely unscreened, and a focus for swarms of flies. The liability to industrial *poisoning* was present for some of the workers in all plants, and particularly so in 7 establishments. Lack of protection from the poisons and the ignorant class of workers employed were the chief reasons. (In this respect each of the processes is considered below.) Penetrating *odors* and stench were the rule. Much of this came from storage bins and quarters as well as from the operations. The industrial inducement to *alcoholism* was great for most of the workers in all plants. The general nature of the business was a factor, while the breathing of dust, irritant

poisons, and in some places the lack of reasonable sanitary conveniences and adequate drinking water facilities added to the inducement.

Excepting some of the by-product processes, a considerable percentage of dissipated or *unhealthy looking* workers were reported by investigators. Their short tenure of employment, however, showed that the industry had little to do with these matters as a rule for a large majority of the workers. However, some old time workers were decidedly under par physically. The chief *complaints* of workers were the breathing of dust and acid fumes which caused coughs, catarrh, sore throat, undue frequency of colds, shortness of breath, pains in the chest, and occasionally fever with definite chills ("bone dust fever"). The possibility of this being pneumonia could not be ascertained. Indigestion, nausea and vomiting, probably due to a gastric catarrh, accentuated by the breathing of foul odors and the swallowing of disgusting dust particles, was also a complaint. In one outlying place a shack was provided which contained about fifty berths, arranged in four tiers, and the whole in a very unsanitary condition. There was also no sewer connections.

COOKING CARCASSES, GARBAGE, ETC. — Rank odor, steam, wet floors.

STORAGE.—Rank odor from organic materials, danger of carbon dioxide asphyxia, especially bone storage.

DEGREASING.—Gasoline exposure, fire danger.

GRINDING BONES.—Exceedingly dusty.

MANIPULATING MIXER AND GRINDING.—Exceedingly dusty, especially for men at top of machines. Dust composed of any or all of the ingredients mentioned above under "dust." Sacks were usually filled directly from this mixer. One worker claimed that there was a peculiar effect produced by the drinking of beer while breathing cyanamide dust, which caused headache, giddiness and nausea. Respirators should be supplied for these processes and their wearing insisted upon. Many of the workers wore rags over their noses and mouths. There is great danger of ulcers forming upon the mucous membranes, and of pneumonia, especially from basic slag dust.

TANKAGE GRINDING. — The grinding up of dried organic tankage produced foul odor and a great amount of dust. In some places one could with difficulty see across the room, while the dust was almost suffocating.

ACIDULATING MIXER. — Dust, usually of mineral character (see under "dust" above), and oftentimes excessive in the breathing atmosphere. In addition there were evolved fumes of sulphur dioxide, hydroflouric acid, hydrochloric acid, carbonic acid, silicon flouride, hydrogen sulphide, and in some processes nitrous acid. The amount of these fumes was usually limited, but the means of confining them varied greatly. In 2 or 3 places there was a suction arrangement which carried off the fumes to a condensor, equipped with a water spray. In other places it was said that the fumes became so bad, especially in warm weather, that everybody had to leave.

SACKING. — This was often done by shoveling and wheelbarrow work, some of the men wearing respirators. It was probably the dustiest of all operations. Some plants were equipped with sacking machines, automatic scales, etc.

GLUE EXTRACTION AND EVAPORATION. — Steam, humidity and nauseating odors.

LEAD LINED TANKS. — See Soldering and Lead Burning.

Comments.—Outside of the obvious necessity for general improvements in sanitary conditions in most of the plants, we cite a few of the precautions mentioned by Doehring, in U. S. Labor Bulletin No. 44, pp. 110-113. Many excellent suggestions are also contained in this bulletin on labor saving devices, accident, fire and explosion prevention for this industry. Readers are also referred to "Industrial Poisons," by J. Rambousek, pp. 261-265 (see book citations in Part II.) for the suggestions from the German Imperial regulations.

1. The crude bones must, as far as possible, be stored in dry and well-ventilated rooms.

2. In transporting, sorting, and disintegrating the bones, men with open wounds on the hands must not be allowed to work. The sorting must be done only in an airy and well-lighted room.

3. In crushing works, rolling-ball grinding mills, and chain-pump works, the opening of the feeders must be inclosed or made safe in some other way. The path of the transporting vessels and feeding screws must be efficiently secured.

4. If sulphurous acids are used in the manufacture, ventilating arrangements must be introduced to prevent the escape of the fumes.

5. The injurious dust generated by the comminution and grinding of the bones must be removed as far as possible by suction at its place of production. In case it is impossible to accomplish this, the men must be supplied with respirators, sponges, mouth cloths or other efficient protectors, and their use must be required.

6. The tanks for treating the bones with sulphuric acid must be supplied with contrivances to prevent the escape of injurious and annoying gases and fumes. Crude materials which generate dangerous quantities of fluoric, hydrochloric, or nitric acid fumes must not be treated in open pits. Treatment of bones with nondenitrated acid wastes in open pits must be forbidden.

7. The introduction or addition of sulphuric acid must be so accomplished as to prevent the spilling and scattering of the acid as far as possible. In emptying the acid carboys, lifters for that purpose must be used.

8. Workmen whose eyes are threatened by the spattering of acids must be supplied with eye protectors, and be compelled to wear them.

9. Ground Thomas slag, or other rocks, must be stored only in bags or barrels, or if in bulk, only in closed rooms, which are supplied with mechanical dust suction.

10. In emptying the acid-treatment chamber, a strong and efficient system of ventilation must be employed.

PAINT AND VARNISH.

Paint manufacturing is, with the exception of 2 or 3 establishments in the state of Ohio, strictly a chemical mixing process. That is, the manufacturers purchase the original ingredients (colors, powders, resins, gums, solvents, etc.) and simply grind and mix them up with oil and other vehicles. In the case of varnishes, cooking processes are necessary. With the exception of one railroad company which built its own cars, all of the places investigated were engaged in the mixing of ingredients to make paint and varnish (including enamels, japans, lacquers, putties, sealing wax, etc.).

Our investigations covered 40 establishments in 7 cities, employing a total of 757 men who were engaged in these processes. (The manufacture of Lead

Oxides, Filling Containers, Labeling, Printing, Cooperage, etc., are considered elsewhere).

Machine methods of modern type were employed in 18 of these establishments, and to a large extent in 20 more, while in the remaining 2 places (both small) no mechanical appliances were at hand. There were no unions among the wage-earners. The general attitude of employers toward the welfare of employes seemed good in 19 places, fair in 19 more, but quite indifferent in the remaining 2 (both of which were small places). Endeavors were apparently made to retain the same employes in 32 of the places, while there was some indifference concerning this in the remaining 8, some of which were large establishments. Health appliances, consisting of suction pipes over mixing and grinding processes, hoods over varnish kettles and fans or air-blasts to blow dust away from workers who scooped or shovelled lead oxides from barrels were present in 8 plants, but in only 2 were they numerous enough, and efficient. They were absent in the remaining 32 plants. In a number of these, respirators were furnished, but not much used. It is true that in a small number of establishments, with ordinary care on the part of the workers, there was no necessity for special forms of health appliances. In some 8 plants a "welfare department" was present which gave definite instructions concerning the danger of poisoning from the ingredients used, and such instructions appeared to be proper and sufficient in 5 of these (where direct medical supervision also obtained). Workers would not always assume the obligation of following instructions. In 1 establishment a sick benefit organization existed. The work was very largely unskilled as far as the wage-earners themselves were concerned. The general construction of work quarters was good in 19 places, fair in 10 more, and hygienically bad in the remaining 11. In 5 places (all small) other processes were carried on in the vicinity of paint and varnish mixing, such as labeling, filling containers, soldering and packing. The age-group estimations summed up as follows:

Age-groups.	*No. of Wage-earners.*
Over 50 years	23
45 to 50 years	63
40 to 45 years	56
Under 40 years	615
Total	757

Of the last group, about 20 per cent were under 20 years of age.

As the work was conducted, *dust* in the breathing atmosphere appeared to be negligible in 7 places (where a total of 93 workers were employed), but to be a hazard in the remaining 31. In 23 of these it was decidedly bad (here a total of 460 wage-earners were employed). The dusts were almost invariably of harmful character because of their poisonous nature, or of their mineral nature, principally the first. In many places very little attempt was made to control the dust in various shoveling, scooping, conveying, weighing, stirring and mixing processes, while workers appeared to pay very little more attention to protecting themselves than if they were working in a flour mill and were breathing flour dust. However, in all of the 23 places graded as bad, the fault lay chiefly in the working conditions, such as the absence of confining apparatus to keep the dust out of the breathing atmosphere, the lack of proper washing

facilities, proper clothing, gloves, or respirators. It is also absolutely necessary that such quarters be immaculately *clean,* because of the "kicking up" of dust from the floors, or the stirring of it up from benches, platforms, bins, etc. In this respect 7 places seemed to be kept sufficiently clean and orderly, 10 others fairly so, but the remaining 23 were bad. Thick caking of paints and varnishes on the floors was a common observation. This was due mostly to negligence in cleaning, or the failure to put down papers (as was done in some places) to protect the floor. In many places the floors were caked to the extent of ½ to 1 inch or more with paint accumulations. Floors were often of a very rough type and full of cracks and holes so that cleaning was a difficult problem. In many places, also, simply dry sweeping with a broom or brush, a part of which was done while the quarters were occupied by workers, was the method of cleaning resorted to. In some places very little regular cleaning appeared to be done at all. In 1 place the railings to stairs were covered with paint accumulations. In 6 establishments there was a considerable amount of *dampness,* due to the use of water in certain processes, the escape of steam or the location of the workrooms in basement or other low quarters. Very often, also, the air was exceedingly *dry* and "biting" from the nature of the dusts or fumes which contaminated the atmosphere. Work-quarters were well *lighted* in 32 instances, but not so in the remaining 8 (for at least some of the processes) ; this was particularly so in 4 places, 2 of which were large plants. The general room *ventilation* was considered good in 8 places, fair in 14 more, but bad in the remaining 18. The cause of vitiation of the atmosphere (in addition to dust) was contamination with fumes, vapors, nauseating odors and irritants, and in some instances gas fumes from poorly ventilated heating apparatus. In addition, in some workrooms the air was decidedly stagnant because of close confinement of quarters, and the absence of any artificial arrangements for keeping it in motion. In 4 places a number of workers were more or less continuously exposed to *heat,* especially in the making of varnish, while in some small places there were inefficient heating arrangements for winter work. There was not very much in the process of a *fatiguing* character. Occasionally some workers were employed at very monotonous applications, and hurrying piece-work was occasionally present. However, there seemed to be enough diversity to insure proper recreation, as well as exercise. The workday was 9 hours in 3 places and varied between 9½ to 10½ hours in the remaining 37 places. The noon recess was 1 hour in 6 places, and varied between 40 minutes and 20 minutes in the remaining 34 places. In many of the places the workday was not regular. The liability to contracting *communicable diseases* appeared negligible in 7 places, fairly so in 13 more, but a considerable hazard in the remaining 20 places, the chief features being the use of common towels, unsterilized rags, poorly kept closets (several without sewer connections), common drinking cups, promiscuous spitting upon dusty floors or into refuse piles, absence of cuspidors, occasionally the crowding together of workers, and frequent trivial injuries (which might have been lessened by the use of gloves, and sometimes goggles and other protective devices). In some 5 places attention was givn to medical supervision, but not to the extent of physical examinations in more than one instance. The liability to *poisoning* appeared negligible in 8 plants, fairly so in 7 more, but a bad risk in the remaining 25. The whole range of predisposing factors (see under "poisons" in Part III) were found present in various places. For instance, washing facilities (water, soap, hand brushes, nail files,

wash basins and towels) were entirely absent or practically so in 10 plants. In 1 plant workers had to go down and up three flights of stairs to get to wash quarters. Lead appeared to be the chief poison, with turpentine, benzine (naphtha), amyl compounds, wood alcohol, and various other solvents used in the preparation of enamels, japans, lacquers, and varnishes,—any and sometimes all of these—present in various establishments. In some plants all naphtha mixing was done in an outside shed for fear of fire. Outside of the comments made in Part III, the foolhardy attitude which many workers took toward the risk of poisoning must be cited. This was more so among younger men, while there was usually present an *"anti-example"* in some one or two older men in the plant, who had been exposed to the same conditions for years, and shown no apparent effects of the same. This existence in the "realm of toleration" and living up to the limit of one's reserve powers, has been sufficiently discussed also in Parts II. and III. The industrial inducement to *alcoholism* was present to a vast majority of the workers, with the poison factor (lead especially) as the chief incitant. What is known as "Pieraccini's vicious circle" is the fact that lead in the human system incites the desire for alcoholic beverages, while alcohol, in combination with lead, quickly damages the kidneys and the blood vessels.

The general *appearance* of workers in this industry seemed good in 18 places, but 1 or more sickly looking workers were observed in the remaining 22. There were many *complaints* made about the breathing of dusts and fumes, and various forms of sicknesses, skin troubles, eye troubles, bladder troubles, etc. Nausea, loss of appetite, spells of dizziness, poor sleep, trembling, palpitation, frequent urination, headache, constipation, and eczema or dermatitis were the commonest of the personal complaints. During the course of investigations, our representative came across 31 instances of *occupational diseases,* as follows: lead poisoning, positive, 22, tentative, 4; naphtha (benzine) poisoning, 5 positive. In addition, there were numerous plainly evident instances of the effects of turpentine, dusts, fumes and vapors upon the individuals who worked exposed to them.

Comments.—In summarizing, there were 5 plants which appeared to be model and healthy places in which to work in all respects. A considerable number of others, while not model plants, were safe enough to work in, provided employes were properly instructed and supervised. A large majority of the plants needed many improvements in working conditions, sanitary necessities, mechanical devices, and sometimes changing of methods to render them at all free from health-hazards. Particularly would it appear that placards, informing employes upon the prevention of poisoning, especially lead, should be posted up in all such establishments. The observation of the rules laid down for lead would also lessen poisoning from a considerable number of other noxious materials. Workers should be allowed time to wash before eating, and great stress should be put upon this (one plant allowed all workers 15 minutes in which to wash.) They should not eat in dusty or vapor-laden atmosphere. In one place a man was seen eating with his hands and clothing covered with red lead. Oftentimes workers ate part of their breakfasts after coming to work. (Provided this were done in safe surroundings and with clean hands and lips, it is to be commended, since a full stomach lessens the possibility of ingested poisons' doing damage. Milk is recommended). One plant rotated all workers in the dry lead departments every 30 days and more frequently if any complaints arose. Tobacco and

gum chewing has been abolished in foreign plants which manufacture paints. There is probably no other industry in which a medical supervision of employes is more needed than the one under discussion. Because workers are not stricken down, and sudden deaths from poisoning do not occur, the existence of slow poisoning and the changes in health *status* which years bring about seem to be entirely overlooked. A five-minutes examination of each employe by a competent physician once a month would eliminate an immense amount of this slow poisoning, and greatly benefit the health of workers in this industry. The physician should be informed of every case of illness among workers, whether the same necessitated absence from work or not — in fact, should ask every worker as to his health during the preceding month. The physician would be an excellent means, also, of spreading advice and emphasizing the dangers of negligence. (See Comments under Painting and Varnishing.) (See also "Protective Measures for Varnish and Lacquer Manufacture" by C. F. W. Doehring, U. S. Labor Bulletin No. 44, pp. 82-83.)

PAINT AND VARNISH.—FILLING CONTAINERS.

Many subdivisions of processes, accompanied by varying hazards to health can be made of the paint and varnish mixing industry. Outside of the subprocesses considered previously, it seems best to make but one more classification of workers in this industry. This is the group which has to do with the filling of the various containers for paint and varnish, such as cans, kegs, barrels, etc. Naturally only larger establishments have workers who do this work exclusively. In 15 establishments investigated, there were 203 wage-earners so employed, of whom 35 were females (engaged in 4 plants). The work was done by mechanical methods almost altogether in 3 plants, and to a large extent in most of the remaining. An intelligent type of wage-earners appeared to be hired in 8 places, while a considerable number of ignorant, and often non-English speaking persons were employed in the remaining 5. The retention of the same personnel of workers was aimed at in all except 2 or 3 large places. In 2 places, room ventilating arrangements were at hand, as well as hoods and other arrangements for confining dusts and noxious materials. In the balance, these were absent, in many of which they should have been present. The general construction of work quarters was graded as good in 5 places, fair in 6 others and hygienically bad in the remaining 4. Other processes (Paint and Varnish Making) were present in a number of places, but the tendency was to put the filling of containers in separate quarters. The age-group estimations for this group of workers summed up as follows:

Age-groups.	*No. of Wage-earners.*
Over 50 years	4
45 to 50 years	16
40 to 45 years	19
Under 40 years	164
Total	203

Of the latter age-group about 20 per cent were under 20 years of age.

In some 4 establishments there was a hazardous amount of *dust* in connection with the process, which was particularly bad in 1 small place. Quarters were kept *clean* and orderly in 6 places, fairly so in 7 more, but not so in the remaining

2. In 1 good sized place workers' hands, clothes and the floor were smeared with paint in the filling of cans. *Lighting* was not good in 3 places, particularly for workers in certain parts. The general room *ventilation* was good in 4 places, and better, on the average, than in the other process rooms in the remaining 11 places. There was, as a rule, more piece-work in connection with filling the containers than in the mixing of ingredients, but *fatigue* did not appear to be a serious hazard any place. The workday was the same as described for the other processes. The risk of *poisoning* appeared negligible in 2 places, fairly so in 9 others, but considerable in the remaining 4, due, principally, to the breathing of fumes and vapors, which escaped while paint and varnish solutions were being conveyed, injected or poured into containers, and otherwise handled. There was also considerable risk from the getting of poisons upon the hands and transferring the same to the mouth and lips. This was greatly enhanced because of the absence of proper washing facilities in most places, and the lack of caution and supervision of the workers. Many of them were found to be under the impression that this process of the work was quite without danger of poisoning when such was not the case. Oftentimes, little mistakes in personal precautions were the sole reasons at hand for poisoning.

The general *appearance* of the workers rated well in 10 places, while 1 or more sickly looking, and probably chronically poisoned, persons were found employed in the remaining 5 places. *Complaints* were much less frequent than noted in other processes, but were of the same general nature. Our investigators came across 4 cases of lead poisoning in 2 plants, among workers who were filling paint containers, while a number of hearsay cases of illnesses which were probably due to poisoning by various paint and varnish ingredients, were brought to our attention.

Comments. — The idea that these processes have no more hazard in connection with them than those of any general factory process of inspecting, packing, etc., must be corrected. Particularly should employes be freed from the necessity of breathing fumes and vapors (a fact which is accomplished in some plants), and placards concerning personal precautions should apply to this group of workers the same as to those in the other processes. Where lead compounds are put up, medical supervision should be instituted. (See Comments under Gluing, Pasting and Labeling.)

OILCLOTH AND LINOLEUM.

The manufacture of oilcloth and linoleum is a limited industry in the state. It was investigated in 3 establishments where a total of 240 men were engaged in the various processes. Strictly modern methods obtained in all places. The attitude toward the help, the type of workers and their retention at the workplace appeared good in all places. Certain forms of health appliances such as ventilators were present in some parts where needed in 2 establishments. The general construction of work quarters was hygienically good in parts of 1 plant, fair in 2 other plants, but not good for other parts in the first plant mentioned. Processes were usually separated from each other. A fair percentage of the workers were skilled, but very few were over 40 years. One plant was equipped with bath conveniences, soap and towels being furnished. Two plants were practically without washing facilities. Bubbling fountains were also present in 1 place, individual cups in another, while toilets were fair throughout. There was considerable scarcity of cus-

pidors and spitting was noted about the floors, although anti-spit signs were posted up in 2 plants. The workday was 9½ to 10 hours in all places, with ½ to ¾ hours for noon recess. Some workers, however, finished up within 7½ to 8 hours.

MANFACTURE OF BOILED OIL.—This was carried on in quarters by itself. A certain amount of litharge and red *lead* were added to the linseed oil, and required the services of 2 or 3 men in each plant. There was some *dust,* depending upon the care used in handling the powders. Boiling the oil was accompanied by some *heat* and the usual *odor* of linseed oil. Hoods should have been present everywhere. None of the workers appeared to have suffered directly from any of the hazards indicated.

MIXING INGREDIENTS.—The mixing of various ingredients such as china clay, boiled oil, benzine, lithopone and lead compounds was accompanied by some *dust* from the grinding machines, while the floors were pretty well covered with the dried paste. The general process did not differ from the Manufacture of Paints. Quarters were *dark* and not well *ventilated* in 1 place. In 1 place it was said no *lead compounds* were used, but otherwise it was hazardous where washing facilities were absent. *Dermatitis* of the hands and arms was noted. Greasing the skin or wearing gloves would largely prevent this.

FIRST COATING AND TENTERING.—Here the first coat, composed principally of casein or other albuminous substances was applied to the fabric and dried on machine stretchers which tentered the cloth to prevent shrinking. Clay, water, oil and ammonia were other ingredients, the odor of *ammonia* being slightly noticeable. Clay *dust* was abundant from the rolls in making the application in one establishment and was uncontrolled.

COATING AND DRYING.—Here the fabric received its subsequent coats of various composition by passing through calendering rolls and from these to drying rooms, heated by steam pipes, and in one instance, equipped with humidifiers. There was a fair amount of *fumes* noticeable in this process, and a great degree of *heat.* The work was rather *monotonous* and required prolonged standing. There appeared to be some risk from benzine and the *lead compounds* used, the latter depending especially upon personal carelessness. In 1 place the men were stripped to the waist (summer season), and room *ventilation* appeared very poor. Steam and high *humidity* was a marked feature of drying rooms. One building was equipped with large ventilators in the ceilings. Ventilation here seemed quite good, but the heat was marked.

DYE HOUSE.—Anilin dyes were used principally. *Steam* and *humidity* were rather marked in one place.

PRINTING OR STAMPING ROOM.—This was done in a similar manner to lithographing. A *benzine* solvent used in the inks was readily detected in the atmosphere.

VARNISHING THE FABRIC.—In 1 plant the management was contemplating the installment of a ventilating system for this department because of the intensity of turpentine and other *fumes* which became so strong that men were not able to stand the work at all.

Some other processes such as TRIMMING, EMBOSSING, INSPECTING, and ROLLING did not differ from the usual types of general factory processes.

Comments.—For protective devices readers are referred to Doehring's article in U. S. Labor Bulletin No. 44, pp. 70-81.

PART VI.

CLASSIFICATION OF OCCUPATIONAL DISEASES AND COMPLAINTS BY INDUSTRIES AND PROCESSES.

There is included in this Part a summary of the occupational diseases and disabilities which were reported to the Division of Occupational Diseases during 1913 and 1914 (with but few exceptions all were reported between July, 1913, and November 30, 1914). Duplicate reports have been excluded and only cases are included, which were personally seen and reported by physicians, and for each of which there is a personal record in the files of the office, with the exception of a few instances where employers themselves reported specific cases.

The following have been the sources of information:

(1) Deaths from Occupational Diseases.—These are very difficult to obtain any record of, principally because some terminal complication is the immediate cause of death. The following is taken from the death certificates of the State Bureau of Vital Statistics, and is for *lead poisoning* only. There is no way, from the certificates, to ascertain which were occupational in character and which were not, but it is very probable that practically all were due to occupational poisoning (only those of 1913 have been included in the large table):

RECORDED DEATHS FROM LEAD POISONING, OHIO, 1909-1913.

Occupation.	*1909*	*1910*	*1911*	*1912*	*1913*	*Total.*
Artist	1	..	..	..	..	1
Farmer*	..	..	..	1	2	3
Laborer	..	2	..	..	..	2
Lead Worker	..	..	1	..	1	2
Machinist	..	1	1	..	..	2
Merchant	..	..	..	1	..	1
Miner	..	..	..	1	..	1
Painter	6	6	6	10	11	39
Potter	..	1	..	1	..	2
Printer	1	..	..	1	1	3
Rubber Worker	..	1	1	..	..	2
Tinner	..	1	..	..	..	1
Totals	8	12	9	15	15	59

* One farmer died, according to a note on the death certificate, from "Lead poisoning from accidental gun-shot wound of 26 years standing". This tendency for lead, stored in the body, to go into solution years afterward and produce poisoning is well known. This instance, of course, was not occupational.

(2) The records of dispensaries, hospitals and charitable institutions in five of the largest cities were examined. They gave very little specific or trustworthy information and most of this was prior to 1913, and too old for use. There was no filing of "Occupational Complaints." One investigator commented upon this in one of the largest hospitals as follows: "Because of manner of keeping records it was very hard to ascertain whether diseases could be attributed to occupation; 3,400 histories were looked over." In short, what should have been a very valuable source of information proved practicaly worthless. The reasons for this and suggestions for meeting the situation are taken up in Part VIII. A large percentage of the adult patients with medical afflictions in these institutions are occupationally afflicted—some partly so, others wholly so.

(3) The reporting of cases by company physicians according to certain legal requirements mentioned elsewhere yielded a total of 68 cases, all lead poisoning. Unfortunately the "lead law" is so narrow—it specifies "manufacturers" only of certain lead compounds, thus omitting compounders, mixers, users, etc.—that less than half a dozen establishments in the state can be considered as coming under it. In fact all of the above mentioned reports were received from the physicians connected with four establishments, the greater part of them during the first few months of the survey. We believe the reporting law has been lived up to quite carefully by them, and with the gradual falling off of such cases there has been noted a lessening in the severity of the symptoms which the physicians reported.

(4) The Occupational Disease Reporting Law covering all physicians has proved very much of a failure. Some score or so of cases have been yielded from this source. Even these have depended solely upon the philanthropical motives and self-sacrifice of the physicians who reported them, since there is no remuneration for such services, nor is there any penalty attached for ignoring the law. Even the best intentioned physician finds it beyond him to take the time to get the information together which the reporting blank requires, and then five or ten minutes more to fill out the blank and pay the envelope and postage cost out of his own pocket. In addition he feels that he may be jeopardizing his patient's relations with his employer and so sacrifices the good of the other workers to the immediate good of the individual patient. In this respect we may say that our experience with employers throughout the state is that not one in fifty would countenance the thought for an instant that he is "running a house of manslaughter," but would welcome any such information from the physician directly and, furthermore, would be glad to get any sugges-

tions which the physician or the State Board of Health might be able to furnish. It is pointed out, also, that such reported information cannot be made use of for any legal purpose, while it has always been considered strictly confidential in this office. If physicians were allowed a dollar or two for reporting the details of an occupational disease—much less than they are allowed for doing the same for an average insurance application—it is more than likely that the State Board of Health would soon be busy enough with the handling of such reports. While it is true that the average physician does not see many cases of lead poisoning, for instance, almost anyone questioned upon the subject can cite a case of bronchitis, or nephritis, or tuberculosis, a considerable part of the cause for which has been some industrial health-hazard, and usually one the seriousness of which any employer would be glad to have brought to his attention.

(5) Hence the majority of the cases tabulated below have been the findings of the special staff of physician-investigators employed by the State Board of Health. The cases reported from all sources have been carefully classified by the Statistical Department. Reported cases were of four types: (1) "positive," in which the specific symptoms and signs were present as well as the specific health-hazard or hazards; (2) "tentative," in which disability was present but enough specific symptoms or signs were not present to make a positive diagnosis, although the hazards were present; (3) "past cases," in which the specific symptoms or signs were present prior to the advent of the year 1913; and (4) "hearsay cases," in which information which could be regarded as authentic was at hand as well as the actual evidence of the hazards. Only the first two types of cases have been included in the figures. In the last column the director of the survey has made an attempt to portray the probable prevalence of such cases as have been enumerated, basing his opinions upon the number of "past" and "hearsay" cases reported in by investigators, the extent and character of the health-hazards present, and his industrial and professional experience. This table may be taken as very conservative in that it does not give all of the occupational diseases which occurred under each industry, simply because no intensive or prolonged investigation was made of any industry so that only such cases as were found present at the particular time of investigation, either in the plants investigated or in the community, have been listed; these makes up the bulk of the figures, and to these have been added all cases reported by other physicians. For instance, in the Clothing Industry no cases of occupational neurosis (brachial neuritis, or arm palsy) is reported, although dispensary experience shows that it is quite common among ironers and

pressers, of whom there are thousands in the cities of the state. Such information, however, is to be found under the description of the various processes in Part V.

In the last column the signs have the following significance:

(+)	an occasional case occurs.
+	a small percentage of cases occurs (say 1 to 5% of those engaged).
++	a larger percentage of cases occurs (say 5 to 10% of those engaged).
+++	a still larger percentage of cases occurs (say 10 to 15% of those engaged).
++++	a large percentage of cases occurs (say 15% or more of those engaged).

The tuberculosis cases listed ("industrial tuberculosis") have been very largely received through a special arrangement with the Cleveland Board of Health whereby for ten months during the year 1914 the moral hazards, domestic and housing hazards of occupied persons who were suffering from tuberculosis were carefully compiled. Then industrial hazards, as found by investigators, were correlated with the individual cases, with the result that the numbers specified after each industry are to be considered as "industrial tuberculosis," more or less engendered and promoted by such occupation. Some of the cases were also reported from Cincinnati, and a few from other places.

TABULATION OF OCCUPATIONAL DISEASES AND DISABILITIES BY INDUSTRIES, TRADE PROCESSES, TYPES AND NUMBERS OF CASES.

Industry.	Trade process from which cases of disease or disability were reported.	Diseases or disability reported.	Number of reported cases of diseases or disability by type of case.		
			Positive.	Tentative.	Probable Total.
Agricultural Implements	Painting, enameling	Benzine poisoning	3	....	++
	Painting, bronzing	Lead poisoning	4	1	++
	Metal grinding	Siderosis	2	....	++
	Metal grinding	Tuberculosis	....	2	++
Automobiles and Parts	Varnishing	Conjunctivitis	1	....	++
	Tempering	Cyanide ulcer	....	....	++
	Machine shopping	Dermatitis (lard oil)	1	....	++
	Welding	Eye strain	1	....	+++
	Adjusting carburetors	Gas poisoning	1	....	+
	Carpentering on primed work	Lead poisoning	2	....	++
	Painting, sanding, etc	Lead poisoning	72	5	++++
	Tempering	Lead poisoning	2	1	++
	Not specified	Lead Poisoning	3	....	++
	Metal grinding, polishing	Siderosis	3	....	++
	Painting, varnishing	Turpentine poisoning	....	....	++++
	Various processes	Tuberculosis	17	....	++
Babbitting Metals and Solder	Melting	Lead poisoning	1	1	+++
Bakery Products	Various processes	Tuberculosis	5	....	++
Bicycles, Sewing Machines, etc	Brazing	Brass chills	6	....	+
	Molding	Brass chills	1	....	++
	Painting, varnishing	Lead poisoning	2	....	++
	Miscellaneous	Tuberculosis	1	....	++

TABULATION OF OCCUPATIONAL DISEASES AND DISABILITIES BY INDUSTRIES, TRADE PROCESSES, TYPES AND NUMBERS OF CASES—Continued.

Industry.	Trade process from which cases of disease or disability were reported.	Diseases or disability reported.	Number of reported cases of diseases or disability by type of case.		
			Positive.	Tentative.	Probable Total.
Boots and Shoes	Blackening, polishing	Amyl acetate poisoning	1	1	+
	Paper box making	Appendicitis	1	3	+
	Cementing	Benzine poisoning	1	....	++
	Finishing	Benzine poisoning	1	....	++
	Blackening	Dermatitis	1	....	++
	Closing	Dermatitis	1	....	+
	Lasting	Glue fumes (?) intoxication	1	....	(+)
	Box toe making	Methyl alcohol poisoning	1	....	+
	Fitting and lasting	Methyl alcohol poisoning	4	....	++
	Polishing	Fume poisoning	2	....	+
	Various processes	Tuberculosis	3	2	+++
Boxes, Fancy and Paper	Sewing	Bronchitis	1	....	+
	Paper box making	Dermatitis (glue)	1	....	+
	Gas producing	Gas poisoning	1	....	+
Brass and Bronze Products	Painting, varnishing, etc	Benzine poisoning	....	2	++
	Brass founding	Brass chills	73	....	++
	Buffing, polishing	Brass itch	7	....	+
	Acid dipping	Dermatitis (acid)	1	....	+
	Enameling	Enamel fumes poisoning	....	1	++
	Brass founding	Gas poisoning	1	....	+
	Brass founding	Lead poisoning	2	2	++
	Soldering	Lead poisoning	1	....	++
	Plating	Rhinitis	4	....	+

	Various processes	Tuberculosis	8	....	+++
	Die casting	Zinc chills	1	....	++
Brooms	Miscellaneous	Tuberculosis	1	....	+++
Caisson Work	Tunneling	Compressed-air illness	1	....	+
Canning and Preserving	Soldering	Rhinitis (fumes)	1	....	+
Carriages, Wagons and Parts	Painting, varnishing	Bursitis, olecranon	1	....	+
	Painting, sanding	Lead poisoning	42	13	+++
	Painting, wet rubbing	Rheumatism	....	1	++
	Miscellaneous processes	Tuberculosis	6	....	+++
	Painting, varnishing	Turpentine poisoning	....	2	++++
Cars and Repairs (by railroads)	Furnacing	Blind spells (light?)	1	....	(+)
	Brass founding	Brass chills	10	....	++
	Carpentering on primed work	Lead poisoning	1	....	+++
	Painting, varnishing	Lead poisoning	1	3	++
	Soldering	Lead poisoning	1	....	++
	Painting, varnishing	Fume and vapor irritations*	....	....	+++
	General labor	Tar pitch (creosote) poisoning	1	....	++
	Various Processes	Tuberculosis	8	....	++
Cars and Repairs (not by railroads)	Painting, varnishing	Lead poisoning	6	1	++
	Machine shopping	Occupational neurosis**	4	....	+
	Miscellaneous	Tuberculosis	1	....	++
	Painting, varnishing	Turpentine poisoning	1	....	+++
Cash Registers and Calculating Machines	Brass founding	Brass chills	10	....	+++
	Tempering	Lead poisoning	2	....	+
Chemicals	Lead burning	Lead poisoning	1	....	++
	Ore crushing, kilning	Lead poisoning	5	....	++
	Various processes	Respiratory catarrh	1	....	++
Clothing and Textiles	Cleaning, dyeing	Dermatis (dye)	1	....	+
	Various processes	Tuberculosis	33	2	++++
Coffins, Vaults, etc	Lacquering	Anemia (amyl alcohol?)	1	....	++
	Polishing, buffing	Bronchitis	1	....	++
	Brass and lead founding	Lead poisoning	3	1	+++
	Painting, varnishing	Lead poisoning	3	1	++
	Polishing, buffing	Lead poisoning	7	....	++++

* Creosote poisoning.
** Pneumatic tools.

TABULATION OF OCCUPATIONAL DISEASES AND DISABILITIES BY INDUSTRIES, TRADE PROCESSES, TYPES AND NUMBERS OF CASES—Continued.

Industry.	Trade process from which cases of disease or disability were reported.	Diseases or disability reported.	Number of reported cases of diseases or disability by type of case.		
			Positive.	Tentative.	Probable Total.
	Soldering	Lead poisoning	....	2	++
	Painting, varnishing	Turpentine poisoning	1	....	+++
	Miscellaneous	Tuberculosis	1	....	+++
Cooperage	Coopering	Tuberculosis	4	....	++
Copper, Tin, etc.	Machine shopping	Lead poisoning	1	....	++
	Soldering	Lead poisoning	2	....	++
	Galvanizing	Zinc poisoning	1	....	+
	Tinsmithing	Tuberculosis	2	....	+++
Cordage, Twine, Jute	Various processes	Bronchitis	3	....	++++
	Combing, stranding	Dermatitis (oil)	2	....	++
	Various processes	Tuberculosis	1	1	+++
Cutlery and Tools	Tempering	Lead poisoning	7	1	++
	Metal grinding	Occupational neurosis	....	1	+
	Metal grinding	Siderosis	4	....	++++
	Various processes	Tuberculosis	5	....	+++
Dry Cleaning and Dyeing	Dry cleaning	Benzine poisoning	3	....	++
	Dyeing, cleaning	Benzine poisoning	4	1	+
	Dyeing, cleaning	Dermatitis	1	....	+
	Miscellaneous	Tuberculosis	1	....	+++
Electrical Apparatus, etc.	Dry batteries	Anthracosis	....	1	++++
	Brass founding	Brass chills	12	....	++
	Mixing chemical	Burns (zinc chloride)	2	....	+
	Incandescent lamps	Conjunctivitis, eye-strain	1	....	+++

	Pitching	Dermatitis (pitch)	1	....	++
	Dry batteries	Eczema (carbon?)	2	....	++
	Dry batteries	Epitheliomata	....	....	+
	Lead burning	Lead poisoning	14	4	+++
	Storage batteries	Lead poisoning	92	4	++++
	Soldering	Lead poisoning	1	2	++
	Carbon brushes	Paraffin poisoning	....	....	+
	Metal grinding, polishing	Siderosis	1	....	+++
	Various processes	Tuberculosis	13	....	++++
Emery Wheels	Babbitting, molding	Lead poisoning	....	2	++
Enameling and Japanning	Enameling	Dermatitis	1	....	+
	Enameling	Lead poisoning	3	3	++
Explosives	Enameling	Benzine poisoning	2	....	++
	Pulverizing charcoal	Bronchitis	1	....	++
	Lead founding	Lead poisoning	....	1	(+)
	Nitroglycerine manufacturing	Nitroglycerine poisoning	....	3	++
	Miscellaneous	Tuberculosis	....	1	++
Fertilizers	Mixing, grinding	Pneumonokonosis	1	....	++++
	Various processes	Tuberculosis	....	....	++++
Files	File cutting	Blepharitis	1	....	(+)
	File cutting	Lead poisoning	2	....	++
	Tempering	Lead poisoning	1	....	++
Flags, Regalia, etc.	Painting	Lead poisoning	1	....	(+)
	Pressing	Occupational neuritis	2	....	++
Foundry and Machine Shop Products	Mixing chemicals	Antimony poisoning	....	1	+
	Brass founding	Brass chills	3	1	++
	Polishing	Bronchitis	1	....	++
	Blacksmithing, etc.	Deafness	1	....	+++
	Welding	Dermatitis	2	....	++
	Electroplating	Eczema (chronic)	1	....	+
	Tempering	Furunculosis	....	....	++
	Die Casting	Lead poisoning	....	2	++
	Founding	Lead poisoning	....	1	+
	Painting	Lead poisoning	2	3	++
	Soldering	Lead poisoning	....	3	++
	Tempering	Lead poisoning	1	2	++
	Founding	Rheumatism (chronic)	1	....	+++

TABULATION OF OCCUPATIONAL DISEASES AND DISABILITIES BY INDUSTRIES, TRADE PROCESSES, TYPES AND NUMBERS OF CASES—Continued.

Industry.	Trade process from which cases of disease or disability were reported.	Diseases or disability reported.	Number of reported cases of diseases or disability by type of case.		
			Positive.	Tentative.	Probable Total.
	Tempering	Siderosis	....	....	+
	Various processes	Tuberculosis	65	....	+++
Fur Goods	Making up garments	Conjunctivitis	1	....	(+)
Furniture and Cabinets	Shellacing, varnishing	Benzine poisoning	1	4	++++
	Polishing	Dermatitis	2	....	++
	Veneering	Dermatitis	3	....	+
	Painting, varnishing	Lead poisoning	6	1	++
	Various processes	Tuberculosis	17	1	+++
Galvanizing	Galvanizing	Brass chills	....	1	(+)
Gas Producing	Gas making	Gas poisoning	3	....	+
Glass Cutting, Staining, Art	Art glass work	HF1 poisoning	1	....	+
	Painting	Lead poisoning	....	1	(+)
	Assembling	Lead poisoning	....	....	++
	Etching glass	Rhinitis	1	....	(+)
	Metal glazing	Rhinitis	1	....	(+)
Glass Manufacturing	Mixing ingredients	Dermatitis (arsenic)	1	1	+
	Decorating	Dermatitis (benzine)	1	....	+
	Mixing ingredients	Epistaxis	2	....	++
	Gas producing	Gas poisoning	....	1	+
	Lead putty making	Lead poisoning	1	....	+
	Mixing ingredients	Lead poisoning	5	....	++
	Various processes	Tuberculosis	4	....	++++
Hats, Fur and Felt	Various processes	Tuberculosis	2	....	++

Instruments (Scientific, etc.)	Metal grinding	Lead poisoning	1	....	+
	Soldering	Lead poisoning	....	1	++
	Electroplating	Cyanide ulcers	1	....	+
Iron and Steel Blast Furnaces	Furnacing	Gas poisoning	3	....	++
Iron and Steel Bolts, Screws, etc.	Various processes	Tuberculosis	8	....	+++
Iron and Steel Forgings	Various processes	Tuberculosis	3	....	+++
Iron and Steel Rolling Mills	Pickling	Acid caries of teeth	24	....	+++
	Painting	Benzine poisoning	3	....	++
	Galvanizing	Brass chills	1	....	+
	Furnacing, hot rolling	Cramps, (heat)	5	....	++
	Furnacing, hot rolling	Gas poisoning	1	....	++
	Furnacing, hot rolling	Heat prostration	2	....	+
	Tinning	Lead poisoning	1	4	+ (+)
	Hot processes	Rheumatism, Lumbago	1	....	++++
	Galvanizing	Ulcers (sal ammoniac)	2	....	+
	Galvanizing	Zinc poisoning	1	1	+
	Various processes	Tuberculosis	4	....	+++
Junk	Smelting	Lead poisoning	....	1	++
	Various processes	Tuberculosis	2	1	+++
Laundering	Washing	Flat-foot	1	....	++
	Various processes	Tuberculosis	10	....	+++
Lead Bar, Pipes, Sheet, etc.	Various processes	Lead poisoning	18	1	++++
Lead Oxides and Carbonates	Various processes	Lead poisoning	36	3	+++
Leather. Tanned and Curried	Enameling	Lead poisoning	....	1	++
Lime Manufacturing	Grinding	Conjunctivitis	1	....	++
	Grinding	Dermatitis	4	....	++
	Slaking	Dermatitis	1	....	++
	Grinding	Dyspnea	2	....	++
	Gas producing	Gas poisoning	1	....	++
	Various processes	Tuberculosis	3	....	+++
Liquors, Malt	Cutting	Bronchitis	2	....	+++
Marble and Stone	Cutting, etc.	Calcicosis	1	....	++++
	Surfacing	Conjunctivitis	1	....	+
	Surfacing	Dermatitis (oxalic acid)	1	....	++
	Surfacing	Pharyngitis	1	....	+
	Various processes	Tuberculosis	5	....	++++
	Various processes	Byssinosis	....	1	+++
Mattresses	Various processes	Tuberculosis	....	4	+++

TABULATION OF OCCUPATIONAL DISEASES AND DISABILITIES BY INDUSTRIES, TRADE PROCESSES, TYPES AND NUMBERS OF CASES—Continued.

Industry.	Trade process from which cases of disease or disability were reported.	Diseases or disability reported.	Number of reported cases of diseases or disability by type of case.		
			Positive.	Tentative.	Probable Total.
Musical Instruments	Sanding	Bronchitis	1	....	+++
	Assembling metal parts	Lead poisoning	....	1	++
	Metal grinding	Siderosis	....	1	+++
	Various processes	Tuberculosis	....	2	+++
Oil Cloth and Linoleum	Mixing ingredients	Dermatitis	....	1	++
Oil Refining	Various processes	Conjunctivitis	3	....	++
	Handling lead pipes	Lead poisoning	1	....	+
Paint and Varnish (Mfg.)	Manufacturing varnish	Benzine intoxication	4	....	+++
	Cleaning with benzine	Dermatitis (benzine)	1	....	+++
	Manufacturing varnish	Eczema	2	....	+++
	Filling containers	Lead poisoning	2	....	++
	Grinding, mixing	Lead poisoning	22	4	+++
	Labeling containers	Lead poisoning	....	....	+
	Soldering	Lead poisoning	1	3	++
	Miscellaneous	Tuberculosis	1	....	+++
Painting and Varnishing (Non-manufacturing)*	House painting	Lead poisoning	21	....	++++
Paper and Roofing Paper	Sizing with alum	Dermatitis and rhinitis	1	....	++
	Various processes	Rheumatism	1	....	++++
	Various processes	Tuberculosis	9	....	++++
Porcelain Enameled Iron Ware	Enameling	Lead poisoning	4	4	++++
Pottery	Decorating	Benzine poisoning	....	1	+
	Glaze dipping	Bronchitis	1	....	(+)

	Decorating and tinting	Lead poisoning	3	3	++
	Fettling	Lead poisoning	1	....	+
	Glaze dipping	Lead poisoning	23	10	++
	Glaze mixing	Lead poisoning	4	4	+++
	Glost kiln	Lead poisoning	15	15	+++
	Helping glaze dipper	Lead poisoning	10	4	+++
	Jiggering	Lead poisoning	....	2	(+)
	Straining glaze	Lead poisoning	1	....	++
	Washing saggers	Red lead poisoning	3	....	+++
	Not specified	Lead poisoning	1	....	+
	Clay mixing	Pneumoconiosis	1	....	++
	Clay mixing	Rheumatism	1	....	+++
	Washing saggers	Rheumatism	1	....	++
	Various processes	Tuberculosis	4	3	++++
Printing and Publishing	Linotyping	Lead poisoning	1	1	+
	Montypting	Lead poisoning	1	....	++
	Printing	Lead poisoning	2	....	+
	Type setting	Lead poisoning	1	....	++
	Printing	Rhinitis	1	....	+
	Miscellaneous	Tuberculosis	9	....	+++
Rubber Goods	Compounding, Milling	Anilin poisoning	1	2	+
	Mixing mills	Antimony poisoning	....	1	+ (+)
	Calendering	Benzine, benzol poisoning	....	2	+ (+)
	Cement mixing	Benzine, benzol, CS_2 poisoning	....	....	++
	Dipping molds	Benzine poisoning	2	....	+++
	Making inner tubes	Benzine poisoning	....	2	++
	Specialty work	Benzine, benzol poisoning	6	1	++
	Tire building	Benzine poisoning	1	....	+++
	Cold cure	CS_2, CCl_4, S_2, Cl_2 poisoning	9	5	++
	Specialty work	Dermatitis	2	....	++
	Making inner tubes	Dermatitis (benzine)	....	....	++
	Cold cure	Dermatitis (CS_2)	....	....	+
	Compounding	Lead poisoning	20	4	++++
	Mixing mills	Lead poisoning	23	4	++++
	Specialty work	Lead poisoning	....	1	(+)
	Various processes	Tuberculosis	4	1	+++

* Ten were deaths.

TABULATION OF OCCUPATIONAL DISEASES AND DISABILITIES BY INDUSTRIES, TRADE PROCESSES, TYPES AND NUMBERS OF CASES—Concluded.

Industry.	Trade process from which cases of disease or disability were reported.	Diseases or disability reported.	Number of reported cases of diseases or disability by type of case.		
			Positive.	Tentative.	Probable Total.
Safcs and Vaults	Polishing, buffing	Bronchitis	....	2	++
	Painting, Sanding	Lead poisoning	6	1	+++
	Various processes	Tuberculosis	1	....	+++
Scales and Balances	Painting	Lead poisoning	7	1	+++
	Metal grinding	Siderosis	1	....	+++
Shipbuilding and boats	Boiler making	Deafness	1	....	++++
	Soldering	Lead poisoning	1	....	++
	Painting	Methyl alcohol poisoning	1	....	+
Signs and Advertising Novelties	Electroplating	Anemia, secondary	2	....	+
	Painting	Lead poisoning	1	....	++
	Various processes	Tuberculosis	1	....	+++
Smelting and Refining	Metal refining	Lead poisoning	4	....	++++
Soap	Cutting soap	Choryza	1	....	++
	Handling soap	Eczema	1	....	++
	Various processes	Tuberculosis	2	....	++
Stereo and Electrotyping	Cast scrubbing	Benzine poisoning	1	....	++
	Cast coating with graphite	Catarrh of resp. passages	1	....	++
	Tending batteries	Eczema	2	....	++
	Casting	Lead poisoning	1	....	+++
Stoves and Furnaces	Blackening	Benzine poisoning	....	1	++
	Metal cleaning	Dermatitis (naphtha)	1	....	++
	Soldering	Lead poisoning	3	....	++
	Mounting, grinding	Siderosis	1	....	++++

	Various processes	Tuberculosis	7	1	+++
Tobacco and Cigars	Various processes	Anemia	....	....	++
	Bunch breaking, rolling	Myopia	....	....	++
	Casing	Rheumatism	1	....	++
	Packing, etc.	Tobacco heart	2	....	+++
	Various processes	Tobacco poisoning	2	4	+++
	Various processes	Tuberculosis	10	....	++++
Toys and Games	Brazing	Brass chills	1	....	++
	Enameling	Dermatitis (naphtha)	....	....	++
	Machine shopping	Lead poisoning	....	1	++
	Brazing	Pruritus	....	1	+
Wire (Works and Mills)	Painting	Benzine poisoning	1	....	++
	General labor	Gas poisoning	1	....	(+)
	General labor	Keratitis	1	....	+
	Galvanizing	Lead poisoning	1	....	(+)
	Galvanizing	Lead, zinc poisoning	....	3	+
	Painting	Lead poisoning	1	1	++
	Stove tending	Lead poisoning	1	....	(+)
	Various processes	Tuberculosis	19	....	+++
Wood, Turned and Carved	Wood working	Asthma, bronchitis	2	....	++
	Various processes	Tuberculosis	1	1	++
Miscellaneous	Unknown processes	Lead poisoning	1	....	—
Miscellaneous	Unknown processes	"Other Occupational Poisons", (deaths)	8	....	—
		Totals	1,204	211	....

ALPHABETICAL LIST OF OCCUPATIONAL DISEASES AND DISABILITIES SHOWING TYPES AND NUMBERS OF CASES.

Disease or Disability.	Number of reported cases of disease or disability by type of case.	
	Positive.	Tentative.
Acid caries of teeth	24	....
Alcohol (methyl) poisoning	6	....
Amyl acetate poisoning	1	1
Anemia (painting, lacquering)	3	....
Anilin poisoning	1	2
Anthracosis	....	1
Antimony poisoning	....	2
Appendicitis	1	3
Benzine, benzol poisoning	33	14
Blind spells (light)	1	....
Brass chills	117	2
Brass itch	7	....
Bronchitis, asthma, catarrh	16	2
Burns (zinc chloride)	2	....
Bursitis (olecranon)	1	....
Byssinosis	....	1
Calcicosis	1	....
Compressed air illness	1	....
Conjunctivitis, blepharitis	9	....
Cramps (heat)	5	....
CS_2, Cl_4, S_2Cl_2 poisoning	9	5
Cyanide ulcers	1	....
Deafness	2	....
Dermatitis, eczema, pruritus, ulcers	39	3
Dyspnea	2	....
Enamel fume poisoning	....	1
Epistaxis (nose bleed)	2	....
Eye-strain (welding)	1	....
Flat foot	1	....
Fume poisoning	2	1
Gas poisoning	12	1
Glue fume(?) intoxication	1	....
Heat prostrations	2	....
Hydroflouric acid poisoning	1	....
Keratitis (wire mill)	1	....
Lead poisoning	544	138
Nitroglycerine poisoning	....	3
Occupational neuritis	2	....
Occupational neurosis	4	1
Pharyngitis	1	....
Pneumonokoniosis	2	....
Rheumatism	7	1
Rhinitis, choryza	9	....
Siderosis	12	1
Tobacco heart	2	....
Tobacco poisoning	2	4

ALPHABETICAL LIST OF OCCUPATIONAL DISEASES AND DISABILITIES SHOWING TYPES AND NUMBER OF CASES. — CONCLUDED.

Disease or Disability.	Number of reported cases of disease or disability by type of case.	
	tive. Posi-	tive. Tenta-
Tuberculosis	301	21
Turpentine poisoning	2	2
Zinc chills	3	1
Other occupational poisonings	8	....
Total	1,204	211

OCCUPATIONAL LEAD POISONING BY INDUSTRIES AND TRADE PROCESSES.

Industry.	Trade Processes.	Number of reported cases of disease or disability by type of case.	
		Positive.	Tentative.
Agricultural Implements	Painting, bronzing	4	1
Automobiles and Parts	Carpentering on primed work; painting, sanding, etc.; tempering; not specified	79	6
Babbitting Metals and Solder.	Melting (soft metals)	1	1
Bicycles, Sewing Mach., etc.	Painting, varnishing	2	....
Brass and Bronze Products	Founding, soldering	3	2
Carriages, Wagons and Parts.	Painting, sanding	42	13
Cars and Repairs (by railroads)	Carpentering on primed work; painting; varnishing; soldering	3	3
Cars and Repairs (not by roads)	Painting, varnishing	6	1
Cash Registers and Calc. Mach.	Tempering	2	....
Chemicals	Lead burning, ore crushing	6	....
Coffins, Vaults, etc.	Brass and lead founding; painting, varnishing; polishing, buffing; soldering	13	4
Copper, Tin, etc.	Machine shopping; soldering.	3	....
Cutlery and Tools	Tempering	7	1
Elec. Appar., etc.	Lead burning, storage batteries, soldering	107	10

OCCUPATIONAL LEAD POISONING BY INDUSTRIES AND TRADE Processes—Continued.

Industry.	Trade Processes.	Number of reported cases of disease or disability by type of case. Positive.	Tentative.
Emery Wheels	Babbitting, molding	....	2
Enameling and Japanning	Enameling	3	3
Explosives	Lead founding	....	1
Files	File cutting, tempering	3	....
Flags, Regalia, etc.	Painting	1	....
Foundry and Mach. Shop Products	Die casting, founding, painting, soldering, tempering	4	10
Furniture and Cabinets	Painting, varnishing	6	1
Glass Cutting, Staining, Art	Painting, assembling	....	1
Glass Mfg.	Lead putty making, mixing ingredients	6	....
Instruments (scientific)	Metal grinding, soldering	1	1
Junk	Smelting	....	1
Iron and Steel Rolling Mills	Tinning	1	4
Lead Bar, Pipes, Sheets, etc.	Various processes	18	1
Lead Oxides and Carbonates	Various processes	36	3
Leather, Tanned and Curried	Enameling	....	1
Musical Instruments	Assembling metal parts	....	1
Oil Refining	Handling lead pipes	1	....
Paint and Varnish (Mfg.)	Grinding, mixing, filling containers, soldering, labeling	25	7
Painting and Varnishing (Non-mfg.)*	House painting	21	....
Porcelain Enameled Iron Ware	Enameling	4	4
Pottery	Glaze mixing, glaze dipping, straining glaze, washing saggers, glost kilns, fettling, decorating and tinting, (jiggering), not specified	61	38
Printing and Publishing	Linotyping, monotyping, printing, typesetting	5	1
Rubber Goods	Compounding, mixing mills, specialty work	43	9
Safes and Vaults	Painting, sanding	6	1
Scales and Balances	Painting	7	1
Shipbuilding and Boats	Soldering	1	....
Signs and Adv. Novelties	Painting	1	....
Smelting and Refining	Metal refining	4	....
Stereo and Electroplating	Casting	1	....
Stoves and Furnaces	Soldering	3	....
Toys and Games	Machine shopping	....	1
Wire (Works and Mills)	Galvanizing, painting, stove tending	3	4
Miscellaneous	Unknown	1	....
	Total Lead Poisoning cases	544	138

*Ten were deaths.

OCCUPATIONAL DERMATITIS (AND ECZEMA, PURITUS, ULCERS) BY INDUSTRIES AND TRADE PROCESSES.

Industry.	Trade Processes.	Number of reported cases of disease or disability by type of case.	
		Positive.	Tentative.
Automobiles and Parts	Machine shopping (oil)	1	....
Boots and Shoes	Closing, blackening	2	....
Boxes, Fancy and Paper	Paper box making (glue)	1	....
Brass and Bronze Products	Acid dipping	1	....
Clothing and Textiles	Cleaning, dyeing	1	....
Cordage, Twine, Jute	Combing, stranding (oil)	2	....
Dry Cleaning and Dyeing	Dyeing, cleaning	1	....
Elec. Appar., etc	Pitching dry batteries	3	....
Enameling and Japanning	Enameling	1	....
Foundry and Mach. Shop Products	Welding, electroplating	3	....
Furniture and Cabinets	Polishing, veneering	5	....
Glass Mfg.	Mixing ingredients (arsenic), decorating (benzine)	2	1
Iron and Steel Mills	Galvanizing (sal ammoniac)	2	....
Lime Mfg	Grinding, slaking	5	....
Marble & Stone	Surfacing (oxalic acid)	1	....
Oil Cloth and Linoleum	Mixing ingredients	....	1
Paint and Varnish Mfg	Cleaning with benzine, mfg. varnish	3	....
Paper and Roofing Paper	Sizing with alum	1	....
Rubber Goods	Specialty work, making inner tubes, cold cure	2	....
Soap	Handling soap	1	....
Stereo- and Electrotyping	Tending batteries	2	....
Stoves and Furnaces	Metal cleaning (naphtha)	1	....
Toys and Games	Brazing	....	1
	Total Dermatitis Cases	41	3

OCCUPATIONAL BENZINE AND BENZOL POISONING BY INDUSTRIES AND TRADE PROCESSES.

Industry.	Trade Processes.	Number of reported cases of disease or disability by type of case.	
		tive. Posi-	tive. Tenta-
Agricultural Implements......	Painting, enameling..........	3	....
Boots and Shoes.............	Cementing, finishing..........	2	....
Brass and Bronze Products...	Painting, varnishing, etc......	....	2
Dry Cleaning and Dyeing.....	Dyeing, cleaning..............	7	1
Explosives	Enameling	2	....
Furniture and Cabinets.......	Shellacing, varnishing........	1	4
Iron & Steel Mills............	Painting	3	....
Paint and Varnish (Mfg.)....	Mfg. varnish.................	4	....
Pottery	Decorating	....	1
Rubber	Calendering, cement mixing, dipping molds, making inner tubes, specialty work, tire building................	9	5
Stereo- and Electroplating....	Cast scrubbing...............	1	....
Stoves and Furnaces..........	Blackening	....	1
Wire (Works and Mills).....	Painting	1	....
	Total	33	14

OCCUPATIONAL BRASS POISONING BY INDUSTRIES AND TRADE PROCESSES.

Industry.	Trade Processes.	Number of reported cases of disease or disability by type of case.	
		Positive.	Tentative.
Bicycles, Sewing Mach., etc...	Brazing, molding............	7	....
Brass and Bronze Products...	Brass founding, buffing, polishing	80	....
Cars and Repairs (by railroads)	Brass founding...............	10	....
Cash Registers and Calc. Mach.	Brass founding...............	10	....
Electric Appar., etc...........	Brass founding...............	12	....
Foundry and Mach. Shop Products	Brass founding...............	3	1
Galvanizing	Galvanizing	....	1
Iron and Steel Mills...........	Galvanizing	1	....
Toys and Games...............	Brazing	1	....
	Total	124	2

PART VII.

SPECIAL INVESTIGATIONS AND PUBLICITY.

LEAD POISONING — ITS CHIEF CAUSES, WITH OBSERVATIONS ON ITS DIAGNOSIS AND PREVENTION.*

EMERY R. HAYHURST.

Etiology — If the "rubbing down" of lead-paste "fillers" and the dry sandpapering of painted surfaces were done away with, about nine-tenths of all cases of lead poisoning, at least as they are reported in the State of Ohio, would be stopped forthwith. The small village and the large city are very much alike in their relative production of cases of lead poisoning. Shop painters and "sanders" including those who work in the paint rooms of many kinds of factories, particularly where wood products are made, as vehicles, automobiles, furniture, etc., and enamelers of wood and iron — these make up the majority of the cases reported. Many of these workers call themselves simply "laborers".

The industries of our state also engage thousands of men in the compounding and mixing rooms of paint and varnish factories, rubber works, potteries, glass works, battery works, enamel works, type making, etc., who are more or less exposed to lead salts in the form of dust.

Lead may get into the human system as follows: (1) the inhalation and ingestion of lead-containing dusts, paints, pastes, enamels or oils; (2) the inhalation and ingestion of lead-containing fumes from molten processes; and (3) absorption through the skin. In the vast majority of instances the form and methods of ingress given under (1) cause the poisoning. The industrial absorption of lead through the skin is now denied by most authorities.

The capriciousness of the individual in his susceptibility to lead poisoning is remarkable. Some develop the acute symptoms within as short a time as two weeks, while again we come across others who have been engaged in the work more or less steadily for a period of 30 to 40 years. Then, after this time the worker may suddenly sicken with all

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the symptoms and signs of acute lead poisoning. Great susceptibility is by far the rule, however. Probably not more than 1 in 10 workers shows any appreciable degree of natural tolerance. On this account most employers of shop painters depend upon a large force of floating labor. Casual workers, however, are about 7 times more liable to develop lead poisoning than are steady employes. This is particularly true in the process of mixing ingredients, "filling," "rubbing down" and "sanding, which do not require much skill. Where numbers are employed at these processes the foremen are accustomed to the dropping out of men after a few weeks' or a few months' work, while some employers are far-seeing enough to insist upon a workman's quitting as soon as the first evidence of colic, digestive or nervous symptoms appears. Other overseers follow the plan of shifting the men about from one process to another so as to keep them in the employ as long as possible, and to conserve their health by as little continuous exposure to lead paint-dust as possible.

I do not mean to imply that lead poisoning is not just as frequent and even more severe in other processes of manufacturing than those just cited, but the total number of workers so employed is quite insignificant when compared to the class under discussion. In at least 150 different industries workers come more or less in contact with lead. In many of these the presence of lead in the fancy branded materials used is not suspected.

One process often engaged in by girls and women in factories is soldering. This is a fairly frequent cause of lead poisoning as solder is usually 50% lead. With females it has a double significance. The sex is peculiarly susceptible to the nervous and mental types of plumbism, and in severe form. While they may have a gradual development of anemia, anorexia, insomnia, with a tendency to vertigo and syncope, not uncommonly acute nervous or maniacal symptoms light up suddenly without a suggestion of prodromes. Further than this, lead affects posterity. M. Paul[1] noted that in 4 women who were habitually exposed to the influence of lead, and had pregnancies, 10 terminated by abortion, 2 by premature confinements, 3 went the full time—but 1 of the 3 children was born dead; so that, out of the whole 15, one, only, lived.

The offspring (32 in number) of 7 men who were suffering from lead poisoning had the following disasters: 11 were prematurely born, 1 still-born, and deaths were so frequent among the infants that at the end of the third year only 3 of the 32 were living. In Chicago a group of 33 married painters, 45 years of age or over, were found to have an average progeny of 2.67 born and 1.79 living. Seven had not

offspring at all. These husbands had descended from parents who had nearly $2\frac{1}{2}$ times this number of offspring. It is not likely that social conditions alone account for this decrease in progeny in the space of one generation.

Diagnosis — *Acute lead poisoning* should be easily diagnosed, but there seems to be a great hesitancy on the part of physicians to make a positive diagnosis. While intestinal colic is fairly constant, other chief features are breakfast anorexia, extending later to all meals; metallic taste; nausea, with or without vomiting; loss of weight; loss of strength; constipation, perhaps alternating with diarrhea; pain in the lumbar region; pains in the joints; headache; drowsiness; insomnia; confusion; blind spells and diziness. In a few days to a few weeks such symptoms are followed by a weakness of the hands, arms, or legs, with a tendency to "wrist drop," and less often "footdrop," "shoulder drop," or even "head drop." The set of muscles most used is apparently the set most affected. Associated with these symptoms is a "blue line" (it may be only a few collections of punctate spots) in the gums in about one-third of the cases only. Invariably there is a peculiar pallor affecting the face, and especially the lips. There may be a slight yellowishness of the conjuctivae, tremor of the tongue, of the hands, and a tremulous voice, while the examining physician may note a weakness in ocular movements and a tendency to "springy pupil" when exposed to the diagnostic lamp. After a short time emaciation may set in, though it is by no means a constant manifestation. Many times the abdominal symptoms are mistaken for obstipation, ileus, hepatic colic, renal colic, vesical colic, tabletic crises and appendicitis. It must not be forgotten that true appendicitis may be present as an accompaniment of the spastic constipation present. Fever is absent as a rule, but various complication may cause it.

When the colic is present there is apt to be present, also, a slow, hard pulse and an increased blood pressure, but these may be counteracted temporarily by the effects of nausea or collapse. It may also be possible to discover basophilic degeneration, or punctate "stippling", in the red corpuscles in a properly stained blood smear, but unless these are present to about the extent of 1 in every 100 red cells they should not be given much significance, for it is well known that they occur in other conditions, such as dysentery, cancer, leukemia, cachectic states, septic processes, and, indeed, in secondary anemias. Their importance as a diagnostic feature has been greatly over-estimated. Furthermore, they are often absent in well-marked cases of acute lead poisoning, or only present at intervals.

Liebermann's intoxication test[2]—*increase* of the resistance quotient of the red blood corpuscles to hypotonic salt solutions (0.45% NaCl)—is much more important than basophilic degeneration, particularly when the intoxication is due to lead. It is necessary to mention that this test may be vitiated in a given case if the individual has been more than usually exposed to benzine, naptha and some other volatile poisons within a period of 48 hours since these cause a *decrease* in the resistance quotient.

The urine in lead poisoning is usually highly acid; indican may be demonstrated to be present in excess (Lavelle's test), while lead can be demonstrated (the electrolytic process advised,[3] — see, also, next article) in many cases. However, as lead is largely excreted by the intestines, the feces prove to be the chief excrement in which to demonstrate the presence of lead. Occasionally, severe cases may show no elimination at all. In such cases it is probable that all the lead is being retained in the body. The presence in the urine of albumen and casts is only of secondary importance since these may be due to so many other factors.

By way of summary, the following features obtain in diagnosing acute and sub-acute lead poisoning:

(1) Lead poisoning should be sought for in all workers and persons exposed to lead in any form, particularly if lead may be inhaled in the form of dust. (All such persons should be considered *suspicious* cases of plumbism).

(2) A "lead line" in the gums means the absorption of lead into the system and its distribution by the blood stream, which, carrying a fraction of the absorbed lead through the capillaries of the gums, permits it to be precipitated and held there through the action of the sulphides in the food. While a true "lead line" shows that the individual is "leaded," still the "lead line" does not mean lead poisoning necessarily, for there may not be enough accumulation in the system to produce any symptoms of intoxication. All "lead line" cases, however, are highly suspicious, and undoubtedly will develop signs of intoxication, particularly if not removed at once from exposure. (A "lead line case" warrants a *tentative* diagnosis of lead poisoning).

(3) Lead demonstrated in the urine does not furnish proof-positive evidence of lead poisoning, since the metal is, perchance, being eliminated as fast as it is absorbed, i. e., not enough is accumulating to produce intoxication. (*Tentative* diagnosis).

(4) Lead demonstrated in the feces, also, does not warrant a diagnosis of lead poisoning by itself. It does not even imply lead absorption, for the lead may have been ingested in an insoluble and non-

absorbable form. In fact, lead may be absorbed through the respiratory tract and eliminated through the intestinal mucous membrane, but its mere demonstration in the feces does not prove lead poisoning for the same reason as just stated in connection with the urine. (Again, only a *tentative* diagnosis).

(5) Lead poisoning actually exists when *evidence of actual intoxication* is added to a history of exposure, or is added to (a) the

Fig. 100. Lead Poisoning.

The photograph shows the dark lead line in the gum margin, as well as on the teeth.

sign of absorption, i. e., the "lead line", or (b) the absolute sign of elimination, i. e., lead in urine. (*Positive* diagnosis).

(6) This necessitates a statement of the early signs and symptoms of lead intoxication. The chief constant and early physical *sign* of lead intoxication is *pallor* of the face, including the lips, which is due more to arterial spasm, (peripheral or centric?) than to anemia. The chief *symptoms* are, in somewhat descending order, *digestive dis-*

turbances, insomnia and *weakness.* Unless the pallor is due to temporary nausea or collapse, it will usually be found to be accompanied by an *increased blood-pressure.* The Liebermann test will be found positive in acute cases.

(7) The sodium sulphide test (Na_2S, 5% solution) applied with an applicator to the hands, arms and face, is very useful in demonstrating the exposure to lead in the case of a workman ignorant of the materials to which he is exposed, and where the metal has had a chance to get into the epithelium of the exposed parts. A brown or black line will often result in a painter, even after ten days or two weeks from the time of his last exposure, in spite of many ablutions in the meantime. The test is invaluable in the factory "wash-up" room as a means of determining whether ablution has been thorough enough. In this case the solution may be kept in a pail and the supposedly cleansed hands dipped into it. The fact that the discoloration may be due to other black sulphides, such as mercury, copper, bismuth and nickel is almost negligible since painters are so little liable to exposure to such metals.

Chronic lead poisoning—Those workers who do not develop symptoms of acute or sub-acute lead poisoning may be considered as having superior eliminative capabilities. But with these a slowly accumulating set of signs and symptoms throughout years of time ultimately ends in premature senility, various degenerative diseases, or the sudden onset of Bright's disease, heart failure, pneumonia, influenza, tuberculosis, pleurisy and the like. In fact, long-period workers appear to go to pieces suddenly in the end. With these there has undoubtedly been progressing, for a long time, fibrosis affecting especially the arterioles of the kidneys and of the intestines. Of 100 house-painters recently examined in the city of Chicago[4] (these are less exposed to lead than the indoor factory-painters) indications of chronic plumbism were found in 59 instances, or 59%, while 26 gave a clear history of acute lead poisoning at some time in the past. As there is an average of seven painters to every 1,000 of urban population, the State of Ohio has something over 20,000 workers so engaged.

The first 100 deaths in a large Painters' Union[5] in Chicago revealed five chief causes: organic heart disease, pulmonary tuberculosis, nephritis, pneumonia and accident at work. The average age at death from these five causes was from two to seven years less than the corresponding death rate in the city at large.

Besides a history of exposure, chronic lead poisoning has for its chief diagnostic factors the following: (1) A diseased condition of the gums which has usually supplanted a previous "leadline". It is not

uncommon to find associated a "lead line," wasted or diseased gums, dental caries with yellowish to blackish discolorations and the absence of many teeth.

(2) Atrophy, particularly of the most used sets of muscles, with accompanying signs of tremors, weakness, muscular inco-ordination, decreased or absent muscular reflexes, and perhaps fibrillations should be sought for.

(3) Vascular hypertention, association with arterio-sclerosis, cardiac weakness upon not undue exercise, and chronic Bright's disease, are very frequent concomitants. The Johnson-Lavis[6] observation that systolic pressure should normally not be over the number of years of age plus 100 for adults is also found to be exceeded in a good proportion of all lead-exposed workers.

(4) "Rheumatism", of chronic type, particularly of the ankles, feet and back is a common complaint. Lead gout or "poor man's gout" may be present.

(5) I would especially call attention again to the weakness of the hand grip in nearly all painters, as demonstrated by the hand dynamometer — this is more apt to be present than signs of weakened dorsi-flexion of the wrist, and is more likely to be found in the hand most used, contrary to the findings in carpenters, blacksmiths, etc.

(6) Unquestionably the application of Barach's[7] Cardia Energy Index (the systolic pressure multiplied by the pulse rate per minute plus the dyastolic pressure multiplied by the pulse rate per minute) would show a degree of hyper-normal energy expenditure in most cases of considerably over the 20,000 mm. of Hg. per minute which he considers the highest admissible for the normal person.

(7) Basophilic degeneration of the red corpuscles, which signifies acute intoxication of progressive character, is uniformly absent in chronic plumbism. So, also, is Liebermann's test.

(8) The urine should be examined for lead, if doubt still exists.

Preventive measures — Various authorities state that zinc can be substituted for lead for all interior painting and to a large extent for exterior work. The rubbing down and dry sandpapering of painted surfaces has been practically eliminated in certain foreign countries, as well as hand work, the latter, by dipping and spraying processes. In many industries wet rotten stone or pumice-stone powder applied with a bass-wood block or piece of felt can be used without the creation of any dust. Finally, the dust arising from sandpapering can be entirely checked by the use of mineral oil to take up the dust. This oil is cheap and does not damage the work nor interfere with speed. The wearing

of wet sponge respirators is an additional precaution, but these will not in themselves prevent plumbism.

Finally, we submit below a table[8] showing the preventive measures which have been adopted in Germany, France and Belgium to prevent lead poisoning among painters. It is applicable to many other workers as well.

COMPARATIVE ANALYSIS OF LEGISLATION RELATING TO LEAD POISONING IN GERMANY, FRANCE AND BELGIUM FOR INDUSTRIES USING PAINT CONTAINING LEAD.

Germany.	France.	Belgium.
Clothes closets.	"Necessary facilities for cleanliness."	Wash water.
Wash and dressing rooms.	Overalls in all moist scraping off, and in painting with white lead.	Soap.
Wash water.	Employers must hang text of law in work places and where men receive wages.	Towels.
Soap.	Scraping off of white lead paint by the dry method is forbidden.	Means to rinse mouth.
Towels.	White lead only used in pasty condition.	Wash before meals.
Nail brushes.	Manipulating with bare hands any material containing white lead forbidden.	Wash before leaving shop.
Must wash before meals.		
No food in work room. No alcoholic drink in work room.	All tools kept clean.	Food brought in to be in tight packages.
No tobacco during work.		No alcoholic drink in shop.
Overalls.		Work clothing and head covering.
Caps.		
Medical inspection every six months.		Medical inspection every 3 months.

COMPARATIVE ANALYSIS, ETC. — Concluded.

Germany.	France.	Belgium.
Leaded man removed to occupation where no contact with lead.	Cleaning must not be done in dry state.	No men addicted to liquor to be employed.
Men breaking regulations after warning to be discharged. Health register. Employers must indicate to workmen the dangers. Employers must hand men copy of the regulations.	After July 20, 1914, "the use of white lead, of linseed oil mixed with lead and all specialized products containing white lead will be forbidden by law in all painting no matter of what nature carried on by working painters either on the out or inside of buildings." (1909.)	Health register. Dry working, scraping or rubbing of white lead surfaces forbidden. Mixing, grinding, manipulation, etc., of white lead or other lead compounds forbidden except when in such way that workers do not come in contact with lead with their hands. (1905).
"The rubbing off of dry paint which cannot be proved to be free of lead must only be done after previous moistening." (1905).		After August 20, 1910, "the sale, transportation, or use of white lead in powder, grains, or cakes, intended for painting is forbidden." For this purpose white lead may only be sold, transported or used in form of paint mixed or ground in oil. (1909).

LIEBERMANN'S RED CORPUSCLE RESISTANCE TEST. — Normal blood corpuscles will hemolize (lose their hemoglobin) in "plain water." So also will they in hypotonic salt solutions of less than 0.5% strength. But the blood corpuscles in lead intoxication *become resistant,* so that in salt solutions as low as 0.4% they may not dissolve. Usually 0.45% is a convenient strength in which to try the test. In contrast to the effects of lead, mercury or phosphorus, which also affect the blood corpuscles, most toxic, debilitated or anemic states cause a *lessened resistance* in the red corpuscles. To make this test the patient must not be plainly suffering from signs of intoxication from alcohol, benzine, or benzol.

(1). By means of a glass pipette, marked at point where one drop of blood comes, place a drop of fresh blood in 5 cc. of a 0.5% NaCl solution contained in a centrifuge tube. Shake gently for two minutes, then add 5 cc. of 1.5% NaCl, and centrifuge quickly for a moment. The fluid above the compact mass of corpuscles in the bottom of the centrifuge tube will be practically colorless if the blood corpuscles are normal, or if they have been rendered hyper-resistant by the acute toxic effects of lead.

(2). To a second centrifuge tube containing 5 cc. of a 0.45% NaCl solution add another fresh drop of blood. Proceed as above. (Both performances

may be done at the same time). In this tube normal blood will show a distinct hemolysis (reddening of the supernatant fluid after centrifuging), but in lead intoxication the solution remains clear, showing that the corpuscles are resistant to the hemolytic action of the hypotonic salt solution.

After a little practice the whole test requires less than three minues, and, as explained, only two drops of blood. The various solutions must all be of the same temperature, that of the room, and an atomizer bulb should be used to blow out the drop of blood from the collecting pipette, since the CO_2 of the breath decreases the resistance. The above is a qualitative test only, but in the original method, definite quantitative relationships can be determined, and stated by a resistance quotient "R. Q.," which is expressible in figures, so that the amount of intoxication may be shown.

THE ELECTROLYTIC TEST FOR LEAD IN THE URINE.—Materials and apparatus (lead-free) — (1) beaker of 200 cc. capacity, (2) evaporating dish of 1 litre capacity, (3) conc. HNO_3 c. p., (4) conc. HCl c. p., (5) NaOH sticks, (6) Swedish filter paper 3 and 6 inches in diameter, (7) cover-glass, or glass funnel, to be inverted over beaker. Also two 5 inch lengths of medium sized platinum wire for electrodes. Platinum truncated cones are better. Also 3 ordinary dry-cells connected in series, with several feet of ordinary insulated bell-wire, brass wire-connectors, a miniature rheostat, a small combined voltometer and ampere-meter (the watch-shape type costing about $2.00 is satisfactory) and 1 or 2 single-blade switches to facilitate control of current. Generate H_2S gas by placing lumps of FeS in a bottle having a glass delivery tube drawn out to a point, adding half-strength HCl whenever gas is wanted. All the work should be done inside of a laboratory hood, to get rid of odors, acid fumes, etc. The whole apparatus can be set up on one small iron standard, with a few rings and clamps. The platinum electrodes are coiled up in the form of spirals, and each connected to a respective wire from the batteries. The electrodes are let down inside of the beaker, so as to be near the bottom, and not closer than ½ inch from each other. Lead in the solution will deposit on the negative pole as PbO_2. To determine the electrode or pole, place a weak solution of NaCl in the beaker containing a drop or two of phenolphthalein indicator; pink color appears at the negative pole when the current is turned on.

PROCEDURE.—A 24-hour specimen of urine is evaporated down until all is contained in the evaporating dish. Then add carefully 30 cc. of pure nitric acid, bring to a boil, evaporate down to a total of 60 cc. This changes all lead present into the nitrate, which is in solution, and the carbon from the organic compounds appear as black flakes. Filter to remove carbon. The filtrate, together with the washings to 90 cc., are now placed in the beaker fitted with the electrodes and covered to prevent foreign matter accidently dropping in. The electrodes should have been previously boiled in a mixture of HNO_3 and HCl to brighten them, then washed in distilled water. The current is thrown on, and adjusted by means of the rheostat, so that about 2 volts is read on the voltometer temporarily attached at the electrodes. This shows the actual delivery current, as there is considerable resistance in the wires at the low voltage used. The amperage will be found to read about 4, but is of variable quantity. The current is continued through the solution for 8 to 10 hours. It is best to immerse the beaker in a water-bath, kept at about 30° to 40°C. by means of an electric lamp, as the current action is better.

QUALITATIVE DETERMINATION.—At the end of the period, throw off the current, remove the electrodes, and any lead present will be shown by a black

or brown discoloration on the negative electrode. To further prove the presence of lead, the electrode is boiled in a test-tube in 2 or 3 cc. of aqua regia, until it has brightened. The electrode is then removed, the solution neutralized with NaOH, and tested to prove lead by the usual qualitative tests. The most delicate of these is that of passing a stream of H_2S bubbles through the neutral, or slightly acid solution, and obtaining the brown or black discoloration due to lead sulphide.

The method is very delicate, making it possible to show as little as 1 part of lead per million, in the original 24-hour specimen of urine. Quantitative estimations may be made by weighing the electrode before and after the experiment, or by comparing the hue of the lead sulphide discoloration in the test above mentioned with a known amount of lead nitrate precipitated by H_2S gas in another test-tube. From 0.032 to 0.16 mgm. of lead have been found by the above method. The method is much more delicate than the magnesium wire test of Hill. It must not be forgotten that an acute case of lead poisoning may show no lead in either urine or feces, since all may be withheld in the system, and none eliminated. This is more likely to be so with the urine than the feces.

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(3) Blyth — *s. v.,* p. 636.
(4) "Hygiene of the Painters' Trade." — U. S. Labor Bulletin, Whole No. 120, May, 1913, p. 51-58.
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(8) From "Occupational Diseases," E. E. Pratt, in "Preliminary Report of the Factory Investigating Commission," New York, Vol. I, 1912, p. 387. There are several other excellent tables of similar sort in this volume for other industries.

THE STANDARDIZATION OF A METHOD FOR THE DETECTION OF LEAD IN URINE.*

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The object of this research has been to develop and standardize a method that could be employed conveniently by a physician to determine lead in the urine. It may be said, in brief, that the *electrolytic test* (this is the method described by Dr. E. R. Hayhurst, in the pre-

* Abstracted from Article in Monthly Bulletin, Ohio State Board of Health, October, 1914.

ceding article) requires very exact conditions and considerable experience. Furthermore, it is not as delicate as the test embodying the precipitation of lead as the sulfide.

Procedure One.— After the sample of urine has been evaporated to about 40 c. c., add 20 gms. of potassium chlorate and 10 c. c. of concentrated hydrochloric acid. Boil: add hydrochloric acid in 10 c. c. portions until the odor of escaping chlorine can no longe be detected. If the solution is water-clear, all organic matter has been destroyed. If it is colored brown or yellow, the above procedure should be repeated. After all organic matter is destroyed, test for lead in accordance with directions which follow later. *Procedure Two.* — Evaporate the sample to a volume of about 20 c. c. Add 20 c. c .of strong nitric acid (sp. gr. 1.42). Evaporate to 10 c. c. keeping the material washed down from the sides of the dish. Flakes of carbon will form and tend to persist if this is not observed. Add 20 c. c. of water. If the solution is water-clear the destruction of organic matter may be regarded as complete. If the flakes of carbon are present, or if the solution is a yellow color, transfer it to a small evaporating dish and evaporate until the residue begins to char or spatter. Mix in 5 gms. of sodium carbonate and heat until the ash is pure white. All organic matter is thus destroyed.

In any case, after the organic matter has been destroyed, make the solution alkaline to litmus by adding ammonium hydroxide. If any iron is present it will appear as a brown flocculent precipitate. If copper is present the solution will assume a bluish hue. If iron is present acidify the solution with HCl. If copper is present add KCN† to the alkaline solution till the blue color disappears. If iron and copper are both present add 0.5 grams tartaric acid, make alkaline and add KCN till the blue color disapears. (The tartaric acid should be examined for lead.) If the test for lead is to be made in *acid solution,* add 5 c. c. of a saturated solution of H_2S in water, or allow the gas to bubble through the solution. If the test is to be made in *alkaline* solution, instead of H_2S in water, a solution of a soluble sulfide, preferably sodium sulfide, Na_2S, may be used; — this does away with having to generate H_2S gas. (Ammonium sulfide is not as desirable because of its strong yellow color.) The darkening produced is practically proportional to the quantity of lead present. In some cases where a very small amount of lead is present a brownish color is produced. In order to confirm this as being due to lead the following

† Great care must be taken not to add potassium cyanide to a solution which reacts acid to litmus paper, because of the generation of dangerous hydrocyanic acid fumes.

further test may be employed. Boil out all excess of hydrogen sulfide, add hydrogen peroxide, full strength U. S. P., and let stand. If the dark color disappears, due to the oxidation of lead sulfide to lead sulfate (which remains soluble in the quantities found here), it signifies that the darkening was due to lead in the form of sulfide. The action of hydrogen peroxide on other black sulfides, as the sulfide of copper, mercury, bismuth, nickel, cobalt and iron, was investigated and in no case is a similar reaction observed. Mercuric sulfide is unattacked, copper, nickel, cobalt and iron give colored solutions. Bismuth yields a white percipitate, due to the formation of basic salts.

In view of the preceding work the following procedure is recommended for the examination of urine for traces of lead:

(1). Evaporate at least 1,000 c. c. of the suspected urine down to about 20 c. c.

(2). The method for the destruction of organic matter with nitric acid is recommended (Procedure Two).

(3). After organic matter has been destroyed dissolve in HCl and make alkaline with ammonium hydroxide.

(4). If copper or iron or both are present make the appropriate additions of KCN and tartaric acid.

(5). Dilute to 100 cc. and divide into two parts, use one for comparison and in the other precipitate the lead with a solution of H_2S gas or with sodium sulfide, 10% solution.

(6). Shake and let stand. If a black or brown color is observed by looking down on the end of the tube, lead is possibly the cause.

(7). To confirm lead, boil out the excess of H_2S (if H_2S was used to precipitate the lead), cool and add 10 c. c. of H_2O_2 (full strength, U. S. P.), shake and let stand 10 minutes. If the black color disappears, the color was undoubtedly due to the presence of lead sulfide, which proves the presence of lead in the sample tested.

The time required for the detection of lead by this method will not exceed 3½ to 4 hours including the time for evaporating the urine, which may be left to an assistant. The actual chemical tests require less than one-half hour. It does not require the undivided attention of the operator and several tests can be run at the same time.

Apparatus Necessary.

1 Evaporating dish — 1,000 cc. capacity.
1 Evaporating dish — 50-75 cc. capacity. Dishes glazed with a lead-glaze should not be used. (Royal Bohemia ware is recommended.)

2–4 Nessler tubes or test-tubes of uniform size and color.
1 Erlenmeyer flash.
A white background to compare colors over.
Ring-stand, rings, Bunsen burner, etc. Keep clean so as not to drop iron rust into solutions.

Reagents Necessary.

(a) *To destroy organic matter:*
(Procedure One) — Hydrochloric acid (Sp. gr. 1.19). Potassium chlorate.
(Procedure Two) — Nitric acid (Sp. gr. 1.42).

(b) *To remove iron or copper occurring as impurities:*
Ammonium hydroxide (weak).
Litmus paper.
Potassium cyanide.
Tartaric acid.

(c) *Test Solutions:*
Hydrogen sulfide or sodium sulfide solution 10% (filter if necessary).
Hydrogen peroxide, U. S. P.

The impurities apt to be introduced through the reagents which have to be considered here are *iron* in the potassium chlorate. A blank test for *lead* should be run on all reagents, especially the potassium chlorate and for the control of all operations. This can be done very conveniently by running a sample of lead-free water along with the sample of suspected urine, adding the same reagents and performing the same manipulations. This solution is also very useful as a blank for comparison.

Results of Urine Analyses.

Nine samples of urine from 5 patients suffering with lead poisoning were examined for traces of lead.—Two of these samples came from Cleveland and 7 from Cincinnati. The collecting bottles were found to yield no detectable amount of lead. In the examination of 8 samples, the organic matter of the urine was destroyed by treating with nitric acid and igniting with sodium carbonate. The organic matter of the remaining sample was destroyed by treating with sulfuric acid and potassium bisulfate. The destruction with nitric acid was a little more convenient and required less time.

The result of the analyses are given in the following table:

Approximate Amount, 24 hr. specimen.	Source of sample.	Date. (1914).	Organic matter destroyed by.	Albumin present.	Lead present.
1200 cc.....	1. Cincinnati....	July 21......	HNO_3	Yes	0.5 mgms.
800 cc.....	2. Cincinnati....	July 25......	HNO_3	Yes	0.0 "
900 cc.....	3. Cincinnati....	Aug. 5......	HNO_3	Yes	0.0 "
600 cc.....	4. Cincinnati....	Aug. 7......	H_2SO_4 & $KHSO_4$	Yes	0.0 "
900 cc.....	5. Cincinnati....	Aug. 9......	HNO_3	Yes	0.1— "
1100 cc.....	6. Cleveland	Aug. 6......	HNO_3	Yes	0.2 "
400 cc.....	7. Cleveland	Aug. 6......	HNO_3	Yes	0.2 "
800 cc.....	8. Cincinnati....	Sept. 3-4.....	HNO_3	Yes	0.0 "
300 cc.....	9. Cincinnati....	Sept. 5-6.....	HNO_3	Yes	0.0 "

Samples 1 and 2 were from the same patient, kiln room laborer in white lead works.

Samples 3, 4 and 5 were from the same patient, kiln room laborer in white lead works.

Sample 6, laborer loading box cars; 10 months previously worked in a lead shop for a chemical company.

Sample 7, laborer in automobile factory; sandpapered old auto-bodies to remove paint.

Samples 8 and 9 were from the same patient, kiln room laborer for one month, and just taken sick.

In conclusion, I wish to thank Dr. Wm. L. Evans, of the Department of Chemistry of the Ohio State University, for valuable suggestions and advice made during the progress of the work which was done at the request of Dr. E. R. Hayhurst.

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Large placards of the form below will be supplied to manufacturers upon request.

NOTICE.

INSTRUCTIONS TO EMPLOYES.

How to Prevent Lead Poisoning.

(1) All workers exposed to *lead dusts, lead fumes, lead solutions* and *lead compounds* are liable to *poisoning.* These poisons get into the body through the *nose* while breathing, or through the *mouth* when chewing, or swallowing, or wetting the lips.

(2) Do all you can to *keep down dust.* When sweeping or cleaning, always dampen with water, oil or wet sawdust. Where dust can not be kept down, you must *wear a respirator.* This must be cleaned out at least once a day.

(3) *Eat breakfast before going to work.* Drink milk at meals, and if possible once between meals. *Do not eat meals in workroom.* Leave work-room at meal times.

(4) Keep *dirty fingers* out of your mouth, and off of your food, and whatever goes into your mouth. *Wash hands, arms and face* with warm water and soap before eating, going to the toilet, or quitting the work-room. Clean your lips and rinse out your mouth before eating or drinking.

(5) A *mustache,* if worn, must be kept short. Do not wear a *beard.* Keep *fingernails* clean and cut short, also loose skin about the nails or hands.

(6) Do not chew *tobacco* or *gum* while at work. Avoid the use of intoxicants in any form, as they promote lead poisoning.

(7) Take a *full bath* with warm water and soap at least *twice a week.*

(8) You must *wear overalls and jumpers* while at work. Wear a cap if exposed to dust or fumes. *Do not wear your working clothes outside of the working place.*

(9) *Keep your bowels moving* if possible once a day. *Report to your foreman* if you notice (1) loss of appetite, (2) poor sleep, (3) indigestion, (4) continual constipation, (5) vomiting, (6) pains in stomach, (7) dizziness, (8) continual headache, or (9) weakness in arms, limbs or body.

Note: Lead poisoning brings on Paralysis of the wrists and arms, hardens the arteries, causes chronic diseases, and hastens old age and death. WORKMAN PROTECT YOURSELF. Your employer and the Board of Health cannot do all for you. OBSERVE THE ABOVE PRECAUTIONS.

OHIO STATE BOARD OF HEALTH,

Dr. E. F. McCampbell,
Secretary and Executive Officer.

Columbus, Ohio.

INSTRUCTIONS TO EMPLOYES IN DUSTY TRADES.

Dangers of Dust.

1. Don't breathe dust of any kind — it causes colds, consumption and pneumonia.

2. Don't sweep during work hours — it spreads germs of all kinds.
3. Don't work in dusty air. Stop the dust or wear a dust protector over your mouth and nose.
4. Dust breathed into your lungs is never breathed out again.
5. If you breathe dust you are bound to cough.
6. Coughing or spitting is nature's warning that your lungs are in danger.
7. If you hem or cough every day see a doctor at once.

FOUR CASES OF SUDDEN DEATH IN A SILO.

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AND

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(Reprinted from The Journal of the American Medical Association Oct. 31, 1914, Vol. LXIII, pp. 1570-1572.)

In view of the constantly increasing importance of the silo for the preservation of fodder on the American farm, it seems proper to draw widespread attention to the danger of fatal asphyxia which may occur to workers in filling and emptying silos. There are no reported cases on record of fatalities under such circumstances so far as we have been able to learn after a careful search of the literature. Agricultural bulletins[1] warn of the danger of carbon dioxid asphyxia unless certain precautions are taken. A sudden death here and there has unquestionably been laid to heart failure, apoplexy and the like.

Since the first American silo was built by Dr. Manly Miles[2], in 1875, the principle has undergone widespread development throughout the country so that the dangers herein cited are liable to beset a large number of persons. The danger from the accumulation of heavy gases in the old type of pit-silos dug in the ground can be easily appreciated, but the instances in question took place in a modern upground metal silo, built about 40 feet high, and free from surroundings which might interfere with ventilation.

At the Athens (Ohio) State Hospital, at about 7 o'clock on the morning of September 19, 1914, four members of a squad of six men ascended the ladder on the outside of the silo in question to an open door about 12 feet from the top, and jumped in, one after the other, on the silage, the level of which was about 6 feet below the doorway. Within five minutes, as reported,

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[1] Babcock, S. M., and Russell, H. L.: Causes Operative in the Production of Silage, 17th Ann. Rep., Wisconsin Agric. Expt. Sta., 1900, p. 131. Crisp, H. L., and Patterson, H. J.: Silos and Silage in Maryland, Bull. 129, Maryland Agric. Expt. Sta., July 1908, p. 10. Erf, Oscar: The Silo for the Dairy, Bull. Agric. Coll., Farmers' Reading Course, Vol. 2, No. 4, Ohio State Univ., p. 3.

[2] Year Book, U. S. Dept. Agric., 1899, p. 616.

Fig. 101. Silos and Dairy Barns at Athens (Ohio) State Hospital.

The metal silo (white) is the one in which four fatalities occurred by gas asphyxia on the morning of Sept. 19, 1914.

the next two men who ascended shouted down that the first four looked as though they were dead. A large force of workers who were at hand immediately ascended the silo, and opening a lower door which was just above the level of the silage, hurriedly removed the unconscious forms, and, in spite of the immediate arrival of four or five physicians from the institution, all attempts at resuscitation failed.

The unfortunate ones, one of whom was 31 years old, and the others 56, 56 and 67, were "trusties" at the institution, and all had been engaged for several years on the institutional farm, and had helped in filling silos for the past two or three years. During the two weeks previous they had helped to fill two large wooden silos nearby, and during the three days previous had helped with the filling of the metal silo in question. Their work was to tramp down the ensilage as it was delivered from the blowpipe. On this morning the machine had not yet begun operations, and apparently the men sat down or lay down on the silage to wait.

To expedite the removal of the victims they had to be let down head first within the 3½-foot chute which surrounds the ladder. In this manner they were passed down from helper to helper to the brickpaved dairy-yard below. All were cyanotic, and respiratory movements had ceased, but it was thought that in three the heart action was still present when resuscitation efforts began. In a few minutes, however, all became pallid, and in spite of an hour's efforts on each one with artificial respiration and stimulants none revived.

On the evening of the same day we arrived at the institution and necropsies were performed on two of the bodies with significant anatomic findings (which were exactly similar in both cases) as follows: A black fluid condition of the blood which flowed persistently from practically all places of incision, there being an entire absence of clots; marked cyanosis of the lungs and mucous membranes of the tracheae and bronchi. The same was true of the livers and kidneys. There was also marked capillary injection of the brains and intestines. Aside from these findings the tissues of the bodies showed no recent changes worthy of comment; especially there were no pathologic conditions of the hearts or vessels to be noted.

The next morning about 7 o'clock we visited the silo in question, where conditions had been allowed to remain as on the previous morning, except that before orders could be issued a couple of feet more of silage had been added. This had apparently sunk 1 foot during the night, leaving about 5 feet up to the bottom of the door in question. However, according to the manner in which the gases are generated (see below), about 10 or 12 feet should have been added, more nearly to reproduce the amount of gas to which the workmen had undoubtedly been subjected. The weather on the two days was practically unchanged, being slightly cool at night and warm during the day. The silage consisted of fresh, rather finely cut, immature corn. Light within the silo was good, owing to open doorways above and in the roof. The temperature seemed about 10 F. higher than that of the atmosphere without. A more peaceful and inviting scene could not be imagined than the warm, pleasant smelling green silage within. With a few moments to spare, the most natural thing for workmen to do would be to sit down or lie down on the silage.

We dropped a guinea-pig within, which, in thirty seconds, toppled over unconscious after a brief exhibit of respiratory difficulty. A rabbit was next

dropped down on the silage. It took a few steps, showed some dyspnea and dropped over on its side unconscious at the end of sixty seconds. Next a large, slender collie dog was lowered down and in just two and three-quarter minutes it likewise fell over unconscious. The oncome of unconsciousness in all cases was very sudden. The animals, after unconsciousness, rapidly turned bluish about the nose, lips, tongue (and ears in the case of the rabbit). The guinea-pig was dead in ten minutes, the rabbit at the end of forty-two minutes, while the dog was removed at the end of thirty-three minutes, when abdominal and chest movements had ceased, although drawing back of the corners of the cheeks was still present. Within a few minutes on the outside, the dog, which had been let down by its tail, showed signs of reviving; at the end of six minutes it appeared partly conscious, and thereafter rapidly recovered without any efforts at resuscitation having been tried. Necropsies on the guinea-pig and rabbit revealed conditions entirely similar to those described above in the cases of the human subjects.

Next a bunch of matches, lowered on a pitchfork tine, snuffed out at a level of about 18 inches above the silage. A lantern behaved similarly, and the level of the gas could be estimated within half an inch by means of the effect on the lantern flame. At this point a gallon bottle of water was lowered, inverted, and a sample of the gas thus collected.

Another half-mongrel dog of medium size was dropped in, but unlike the collie, which sniffed around over the surface of the silage, this dog kept its nose well elevated and showed very few symptoms. At this point one of the investigators jumped in and lowered his head to the top of the silage. A most startling, rather pungent, warm and slightly alcoholic smelling gas caused the investigator to retreat hastily to the open door above. The lower door (just above the silage) was then opened, through which the second investigator detected the same gaseous odor, which irritated the mucuous membrances and the throat considerably, and the effects of which could be felt for fifteen or twenty minutes afterward. There was no odor suggestive of bitter almonds, garlic or rotten eggs (hydrocyanic acid, hydrogen arsenid, or hydrogen sulphid). A few more experiences convinced the investigators, however, that one could rapidly become used to the at-first-unpleasant effects of the gas, and that to workers customarily employed about silos it might not be considered of any moment.

Experiments with animals and lights were made in the two neighboring silos, which had been filled with a riper and drier corn fodder, but all resulted negatively.

The analyses of the gases collected, which were made by Prof. William L. Evans, of the Department of Chemistry, Ohio State University, showed as follows:

A. Sample from the silo in which the deaths occurred:

Gas.	*First Estimate Per Cent.*	*Second Estimate Per Cent.*
Carbon dioxid	38.0	38.3
Oxygen	13.5	14.0
Nitrogen	48.5	47.7

No test could be obtained for carbon monoxid, ammonia, hydrocyanic acid or methane.

B. Sample from one of the neighboring silos (filled, however, the week before):

Gas.	First Estimate Per Cent.	Second Estimate Per Cent.
Carbon dioxid	.20	0.24
Oxygen	20.5	20.7
Nitrogen	79.39	79.06

Likewise no test could be obtained for ammonia, hydrocyanic acid or methane. (Nitrogen was determined by differences in both cases).

According to Rambousek,[3] 10 per cent. of carbon dioxid in the air causes asphyxia, which is usually sudden.

Some peculiar features obain in silos. The initial *heating* of silage is described[4] as due to the direct respiration of plant cells, increased by the cutting of plant tissues, by intramolecular respiration of ensiled material(the chief factor), while (in a tight silo such as this was) the factor of bacterial and mold action is practically negligible.

The *composition*[1] of the air at time of filling is of course the same as the normal atmosphere, but immediately after the cut fodder is ensiled, absorption of oxygen by the plant tissues begins and continues until all of the free oxygen in the air spaces is consumed by the respiratory processes of the plant. This direct absorption of oxygen is nearly, but not quite, counterbalanced by the evolution of carbon dioxid, as a portion of the oxygen combines to form other by-products An analysis of the air even within twenty-four hours often shows no free oxygen. The nitrogen of the air is unaffected by these plant processes.

Within a short time gas begins to be given off, and continues at an increasing rate for a day or so, then gradually diminishes. The gas so evolved is largely CO_2, but is mixed with the residual nitrogen of the contained air. This CO_2 is the result of intramolecular rather than direct respiratory processes, and as the oxygen required for this change is derived from the tissues of the plant, the volume of gas in the silo is increased by the amount of CO_2 formed. The evolved CO_2 is therefore a measure of the intramolecular respiration. The evolution of this gas marks an actual and unavoidable loss in the organic matter of silage. This source is operative so long as life exists in the plant cells, but when the cells die, gas from this source is no longer given off.

. . .

When the gases of a silo are measured, either by volume or by absorption of the CO_2, the production of gas is found to be very rapid for the first few days, and then to diminish quickly in a manner somewhat comparable to the evolution of heat previously referred to. It soon reaches (two weeks or so) a rate that continues with slight fluctuations for some months. Such a rate of gas evolution can only be intelligently interpreted by assuming that most, at least, of the CO_2 evolved is the result of processes inherent to the plant cell, and not to fermentative action set up by organisms which must have developed subsequent to the ensiling of the fodder.

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[3] Rambousek, J.: Industrial Poisoning, translated by T. M. Legge, 1913, p. 201.

[4] Babcock, S. M., and Russell, H. L.: Causes Operative in the Production of Silage, p. 130.

In fact, it is the presence[5] of this carbon dioxid gas which is the principal perserving agent in the silage. The escape of this gas from the silo will immediately start decay. Usually mold does not affect more than the mere surface of the silage and this acts as a seal to prevent the air from decaying the silage to a greater depth. The amount of carbon dioxid developed[6] in a silo filled with immature corn may reach 75 per cent. of the total gases present, the chief remaining gas being the nitrogen of the air.

"The conditions favorable for a maximum evolution of carbon dioxid is an immature corn cut into fine pieces and placed in the silo at intervals"[7](as the daily filling with nightly interruptions).

Fatal asphyxia from carbon dioxid has been reported under the following somewhat similar conditions: among vintners, distillers, brewers, yeast makers, in the holds of grain vessels and in peat pits. But a very great danger exists also in every silo unless precautions are taken. These consist in keeping the doors immediately above the level of the silage open, or in having unhinged doors which fall in as the silage settles below them, while the absence of a roof (which is said not to be necessary) would permit prevailing winds to draw off gases by suction action. The gas can be driven out easily by using an open umbrella, bunch of hay, or leafy branch of a tree to promote diffusion. When any doubt exists, the effects on a lantern flame should be noted.

In case of accident, the Meltzer apparatus, recommended by the Committee on Resuscitation from Mine Gases,[8] would appear to be the best of the mechanical devices available.[9]

We desire to thank Dr. O. O. Fordyce, superintendent of the Athens State Hospital, his staff, and others for their kindly efforts in facilitating investigations. A complete report of this investigation including necropsy findings is given in the *Monthly Bulletin* of the Ohio State Board of Health for October, 1914.

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5. Erf, Oscar: The Silo for the Dairy, pp. 13 and 27.
6. King, F. H.: Influence of Close Packing of Corn in the Silo, etc., 18th Ann. Rep., Wisconsin Agric. Sta., 1901, p. 202.
7. Quoted from letter under date of Sept. 30, 1914, from R. H. Shaw, chemist, Bureau of Animal Husbandry, Dairy Division, Washington, D. C.
8. Technical Paper No. 77, U. S. Bureau of Mines, August, 1914.
9. Resuscitation from Mine Gases, editorial, THE JOURNAL A. M. A., Sept. 26, 1914, p. 1117.

PART VIII.

MEASURES OF PREVENTION.

THE GENERAL PRINCIPLES OF THE PREVENTION OF OCCUPATIONAL DISEASES.

Plainly, the prevention of occupational diseases lies in the elimination of health-hazards from industry.

At once it must be understood that occupational diseases are not necessarily extrinsic poisonings, such as lead, benzine, etc., but are just as much the result of intrinsic poisonings and toxins, which have been generated within the system through fatigue, inactivity, temperature variations, dampness and disease. It is, however, well to consider the cases of extrinsic poisoning as *specific* occupational diseases, and the cases of intrinsic poisonings as *non-specific* occupational diseases, since the health-hazards which produce this latter group are, oftentimes, extant outside of industry, because of various moral delinquencies, domestic habits, etc.; but the moiety which industry causes in these non-specific occupational diseases should not be over-looked, as is now so commonly done and which results in charging all such disasters to factors outside of industry.

"In order to improve the hygienic conditions under which people work, and in order to prevent the diseases of occupation, five fundamental conditions are essential: (1) investigations; (2) laws; (3) factory inspection; (4) penalties; (5) education. It is self-evident that before anything may be accomplished a careful study must be made of the facts. These investigations must include not only scientific studies, but also economic and sociological factors. Suitable laws are necessary, for it has been found in practice that the conditions cannot be corrected by an appeal to voluntary reform. To be effective the laws must provide ample ways and means for their energetic enforcement. A systematic factory inspection is necessary in order not only to protect work-people against the preventable diseases of occupation and to correct sanitary defects, but also to enforce the laws concerning hours of occupation, child labor laws, and related subjects. These laws have little force unless they provide a penalty both against the employer and the employees. Either party to the contract should be held legally responsible in case of violation. Finally, education directed to the employer, the employee, and also to the public at large is necessary to obtain the laws and maintain the standards."—(*Rosenau. Preventive Medicine and Hygiene,* 1913, Page 915.)

Principle I.—If it is hazardous to human lives to produce an article of human usefulness, then the cost of production should include the cost of the conservation of health.

Principle II.—A proper place to work, and safe methods of working, and some knowledge of the dangers to health and life are pre-requisites to conducting any business, or to working, no matter whether one man or a thousand are concerned, and whether the individual is an employer or an employe.

Principle III.—The health of the individual is an affair of the State, since his dependency, wilful or otherwise, becomes a burden upon the State, directly or indirectly.

It seems at this time impossible to prevent occupational diseases by specific legislation; for, the mass of statutes necessary to enact to cover each particular process, and to keep up with the progress of industries and processes, would seem practically incapable of accomplishment. On the other hand, we believe that the entire question can be handled by means of rules embodying instructions and explanations of reasonable and feasible character, created for all the industries of the state by the offices of the State Board of Health, and of such a character that though left to the enforcement of the Industrial Commission of Ohio, they will practically enforce themselves through the common acquiescence of employers and employes, and the extension of the principles of compensation to occupational diseases.

The question of how to compensate for non-specific occupational diseases, such, for instance, as tuberculosis which may be due to several factors other than work conditions, has been solved abroad as follows: If the workman at or before the time of disablement was employed in any process mentioned in the schedule (of health-hazardous processes) and the disease contracted is the disease set opposite to the description of that process (in the schedule), the disease shall be deemed to have been due to the nature of that employment unless the contrary is proved.

Attention is called to what is known as the Overlock Tuberculosis Agreement which is in vogue in the New England States and has been adopted by various chambers of commerce, manufacturers' associations, and individual establishments. The Agreement provides a simple method by which this scourge of humanity can be driven from the factory districts where it now chiefly flourishes. In short, the proposition is that the manufacturer or employer pay for the sanatorium treatment of any of his employes who are so unfortunate as to be stricken with this disease. In Massachusetts, where the movement began, the Rutland Sanatorium is able to treat such cases for $4.00 a

week. The first manufacturer to make the agreement did so in 1908, in the case of a working girl, whose expenses he offered to pay at the sanatorium "for a period of 3 months or longer if necessary." It is claimed that the Agreement now embraces more than 1,200 mercantile and manufacturing establishments, employing approximately 2,000,000 people in the New England States, where it is driving this plague from industry. Before it could be fully adopted in Ohio, more sana toriums must be provided. As stated before, there are some 35,000 cases of the disease in the state. How many of these are in industry it is impossible to estimate.

CORRECTIVE MEASURES RECOMMENDED.

Under each general process and special process described in Part V. are given specific suggestions to meet the hazardous conditions described. We will conclude by giving some general statements.

The corrective measures to be recommended fall under three heads: (1) Information, education and publicity, (2) correlation of industrial health-hazards and occupational diseases, and (3) co-operative legislation.

(1) The supplying of information to the employers of labor in different industries and trade processes upon the forms of health-hazards which have been found to exist in such industries and processes, and the types of occupational diseases and disabilities, the prevalence of tuberculosis and other chronic diseases—all of these are important functions of the state and local health body, and are essential in the elimination of much preventable disease. Along with such information should be supplied an outline of corrective measures which are based upon reasonableness, practicability and economy, and which have been culled from various sources everywhere. The mechanical problems of various installations and devices are, of course, outside of the field of the health officer.

The carrying home to the workers themselves of the fundamental principles of hygiene is very important. Our investigation has shown many instances of entirely wrong conceptions of hygiene which serious-minded workers have advocated. It is usually possible to apply these principles of hygiene directly to the industries and trade processes in question. There is no question that much of the preventable disease rate among occupied persons, perhaps over half of it, is due to the ignorance or misinformation, or sheer non-interestedness of the workers themselves. For poisonous trades and the principal dusty occupations, as well as most of the dozen health-hazards commonly met with, placards of instructions on the avoidance

of such hazards, such as the two simple forms given in the preceding Part can be posted up in work quarters, and arrangements made for their interpretation into the various foreign languages, and their reading at intervals as a definite plan of the factory efficiency. These would help considerably. More important, however, than these is the arrangement for a careful instruction of foremen and overseers in the questions as evolved at each plant. This can be arranged for usually through the local health department, which, if it is not in a position to devote time to this itself, can recommend properly qualified persons, usually physicians (but at least persons skilled in hygiene), to give brief talks at short meetings, and to co-operate by taking observations throughout the work place. Already, today, this plan has been extended, not only to the skilled, but to the unskilled workers in a number of plants in the state, whereby once or twice a month fifteen minutes or so at noon time is taken for a short crisp talk by a properly qualified person upon the questions of hygiene at hand, and the problems which the workers should meet to increase their own efficiency and their own productiveness.

The general public itself is, as a rule, quite indefinitely informed on the principles of "preventive medicine" and hygiene, including industrial hygiene. As practically all adults have to work, it is important that each individual should become acquainted with the health-hazards of his particular calling, for most of which civilization has introduced more or less artificiality, which is not in keeping with the physiological or normal functions of the human being. Publicity through health agents, public health exhibits, lectures, etc., and the preparedness of health agencies to supply the information desired, are the general means of covering this field.

(2) There is greatly needed today a real correlation of occupational diseases and disabilities with industrial malhygiene by treating agencies and institutions, which should adopt forms and means of reporting these correlations to local or state health officials. There is unquestionably a great shortcoming in this direction, which is productive of enormous economic waste. These treating agencies, many of them maintained by the public itself, or by charitable institutions, go through their routine of furnishing aid and succor day after day, without themselves trying to connect up these remnants of social delinquencies with the causes which produced them, nor is the information which they collect recorded in an available form for utilization by corrective agencies. To explain this situation more fully as well as to emphasize corrective measures, the following summary is taken from a recent article by the director of the survey.

THE PREVALENCE OF OCCUPATIONAL FACTORS IN DISEASE, AND SUGGESTIONS FOR THEIR ELIMINATION.*

E. R. HAYHURST.

The purpose of this paper is, first, to point out the socially wasteful practice of administering daily to person after person for the same types of morbidity, due to the same causes, and, secondly, to emphasize a much neglected sphere of etiology, the proper conception of which is contained in the term "industrial relations."

The research summarizes a study of (1) U. S. Census Mortality Statistics of Occupations; (2) 65,000 dispensary records and many hundreds of cases personally seen during a two-year period at Rush Medical College (Central Free Dispensary); and (3) the medical portion of 27,887 cases in which the patients received treatment in Cook County Hospital during the year 1913.

As a result of considerable study of hospital and dispensary cases and records, of vital statistics, and of field investigations, we reach the following conclusions:

SUGGESTIONS FOR THE SOLUTION OF THE PROBLEM OF OCCUPATIONAL DISEASES.

The health-hazards of industry which cannot be feasibly removed are insignificant in number. The best proof is the fact that certain establishments engaged in the industries and processes in question have circumvented such hazards, and invariably to the improvement of production, as well as labor attitude and relations.

1. Occupied persons, other than agriculturists, suffer an enormous mortality (figures show 74 per cent.) from well-recognized preventable and prematurely degenerative diseases.

2. Occupational diseases exist because industrial health-hazards exist. Responsible employers do not realize the existence of either, while treating agencies take little cognizance of employments.

It must not be forgotten that patients themselves are densely ignorant of what constitute health-hazards; that they calmly accept them as a matter of course, and unworthy of notice; that the competition for work is great; and (one comes to realize) so much greater than everything else is *the innate desire in man to work,* especially before middle life — a desire which, in the normal man, equals his appetite and seeks to be satisfied in spite of all conditions.

3. From one-fourth to one-third of the medical afflictions of tradespersons are due in whole, or in great part, to industrial health-hazards.

4. In institutions, the vast majority of industrial diseases are lost sight of through failure to recognize properly the industrial relations of the patients, to make etiologic diagnoses, and to classify properly in subsequent filing.

A principal feature in all these cases is to determine exactly the occupations. The principal result should be an etiologic diagnosis as far as possible, includ-

* Results of a study conducted at the Central Free Dispensary (Rush Medical College) and Cook County Hospital, Chicago, under the Occupational Disease Fellowship of the Otho S. A. Sprague Memorial Institute for Infectious Diseases.—Abstracted from article in *Jour. Amer. Med. Asso.,* Dec. 12, 1914, p. 2093-2097.

ing the use of qualifying terms such as "bronchitis, occupational," "neuritis, chiefly occupational," "aortic aneurysm, probably occupational," "nephritis—alcoholic and lead," etc. This is similar to uses elsewhere, as seen in such descriptive terms as *puerperal* sepsis, *tuberculous* pneumonia, *typhoid* fever and diabetes *mellitus*.

During the course of the year 1913, there were in the hospital *2,230 adult cases of tuberculosis* (I understand that not over 50 of there were "repeats"), 1,800 males and 430 females. One may safely say that practically none of these had active tuberculosis at the age of 14 years! The question is, Why and how have they acquired it since? How many of them would have it now had they lived an agrarian existence, for instance?

5. Specific occupational diseases, such as lead poisoning, are not recognized in more than one out of three or four instances, more especially the chronic cases.

Present-day institutional records are of value only in showing the enormous numbers of representatives of groups of industrial pursuits who are below the physiologic normal, and who seek medical aid for preventable afflictions. Such records have little value to the student of economics. For instance no cases were recorded of *pneumonocomiosis*, or of its various forms, as *siderosis, chalicosis, aluminosis*, etc., although there were a total of 134 cases of *chronic bronchitis* without efforts at etiologic diagnosis.

There were recorded 229 cases of *arteriosclerosis*. Unfortunately an idea of the extent to which fatigue-substances, heat-toxins and extrinsic poisons of industrial origin may have entered into this class of cases can rarely be gained from present-day histories anywhere; hence any idea of using the information for shutting off the oncome of such cases is at once precluded. They are all charged apparently to the account of moral hazards, or disease misfortunes.

7. A most important first remedy is a proper nomenclature for industrial relations to take the place of the word "occupation." Such a nomenclature is here propounded.

TABLE 5.—SCHEME TO TAKE THE PLACE OF THE WORD "OCCUPATION."

INDUSTRIAL RELATIONS

(*As stated by the Patient*)

	Present	*Past*	*Previous (to Past)**
1. Name of employer........................	....	....	....
2. Address of employer......................	....	....	....
3. Business of employer......................	....	....	....
4. Calendar years worked here...............	....	....	....
5. Department(s) worked in..................	....	....	....
6. Particular process(es) engaged in.........	....	....	....
7. Health-hazards† exposed to...............	....	....	....

The chief feature of this is the introduction of the term "industry-department-process" for the word "occupation."

* For acute afflictions it is not necessary to go back beyond a few days or weeks, perhaps. For recurrent afflictions one should go back months or years. For chronic afflictions it is necessary to go back preferably five years or more. It is not to be expected that the busy entry clerk will fill out this record. It should be the duty of the history taker, oftentimes with the aid of an interpreter, and, if significant, even with outside assistance.

† Question "7" should be answered whenever there is any possible relationship between the patient's affliction and his industrial relations.

TABLE 6. — EXAMPLES OF THE COMPLETE STATEMENT FOR "OCCUPATION."

Industry	*Business Dept.*	*Trade Process*
Pottery	Clay shop	Jiggerman
Pottery	Glaze room	Dipper's helper
Vehicle	Painting	Painter and sander
Agricultural implements	Painting	Dipping machine laborer
Iron and steel	Butt mill	Furnaceman
Brass	Foundry	Furnaceman
Iron foundry	Foundry	Laborer
General	Nondescript	Laborer

In this way it is possible to classify any one's trade or calling exactly. As in the case of "iron foundry," redundancies seemingly occur, but these are only apparent, for all the information obtained is necessary to exactly identify each worker's industrial application and environment. Adoption of this proposed term, furthermore, renders a logical classification of occupations possible. No such classification now exists.

8. In spite of the fact that the state in which this study was made (Illinois) has an occupational disease law, workers are still coming into its charitable institutions from the same types of trades, and in some instances, from the same manufacturing establishments, in even greater numbers than at a period three years previous, when the Illinois Commission on Occupational Diseases made its investigation. This, we charge, is most directly due to the non-existence of a correlating body between the hospital and the factory.

9. The powers and functions of the community health-governing body should be extended to the prompt investigation of all industrial complaints, and to the prompt remedying of them without the necessity of preliminary legislation against certain alleged responsible industries.

10. Too much importance is usually given to alcoholism, with a failure to appreciate that subjection to industrial health-hazards in itself induces and promotes stimulantism.

(3) As most of the problems concerned have to do with education and the creation through appeal and psychological means of a receptive and subsequently active state of mind of the masses concerned, it does not appear that much legislation is needed. In fact, in this field, legislation is probably more valuable for education than for what it actually accomplishes. On this account it should be very carefully prepared, of a conservative nature, and flexible in character so as to meet the many problems, often new ones, which arise. In short, enough legislation is needed to permit health-governing bodies to make investigations of specific complaints, determine the merits of the complaints, the kind and degree of health-hazards present, and the responsibility which both employers and employes should assume in eradicating any hazards found. In Ohio, the State Board of Health is in a position to handle the vast majority of these situations through *board of health regulations.*

It is believed that two bills to be introduced, (1) "The Model State Law for Morbidity Reports," and (2) a bill "to Divide the State into Health Districts; to Provide for the Appointment of District Health Officers, Deputies and Assistants; and to Prescribe the Powers and Duties of Such Officers, Deputies and Assistants" will provide such legislation as is necessary.

INDEX.

NOTE — *The cross reference abbreviations used have the following significances:*

D. — Dusts reported as hazards.
O. C. — Occupational complaints reported.
O. D. — Occupational diseases reported.
P. — Poisons reported as occupational hazards.
* — Consult each industry and process described, especially in Part V., where the subject, if it appertains at all, will be found discussed in its proper place and relationships.

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